SAFETY, HEALTH AND ENVIRONMENT HAZARD CONTROL IN A MALAYSIAN PERFORMING ARTS THEATRE PRODUCTION

CHARLENE ANGELA A/P J. N. SUNDRARAJ

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RESEARCH PROJECT SUBMITTED TO THE FACULTY OF ENGINEERING UNIVERSITY OF MALAYA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS IN SAFETY, HEALTH AND ENVIRONMENT ENGINEERING

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ABSTRACT

This research identifies and investigates the Safety, Health and Environment Hazards in a Malaysian Performing Arts Theatre Production. It analyses and quantifies the likelihood and severity of hazards on the well-being of theatre practitioners and members of the public and ascertains measures to prevent the risks. This research is important due to the current lack of regulations on the Malaysian performing arts theatre industry while operating under limited resources. It also seeks to build Safety, Health and Environment data for the Malaysian performing arts theatre industry. Currently, there is no official risk assessment on the production work of small scale Malaysian theatre production companies. As the production process begins with pre-production and production work outside of the theatre, the gap in research on hazards of these work processes are closed using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method on a Malaysian theatre company. The Malaysian company studied is a theatre company that specialises in opera productions with cast members, orchestra, production workers, designers and children. The performance was held at a theatre located in Kuala Lumpur, Malaysia. Each phase of the production was separated according to job steps by location, and hazards were identified accordingly. Each hazard was assigned a risk level according to likelihood and severity and control measures were identified to prevent these risks. It was found that most of the risks faced at the rehearsal space and the theatre were moderate, followed by imminent risk and insignificant risk. At the theatre, the percentage of moderate, imminent and insignificant risks were 64%, 35% and 1% respectively. At the rehearsal space, the risks were 80%, 19% and 2% respectively. Steps to prevent and mitigate the risks were highlighted in the form of recommendations to be shared with theatre practitioners and implemented in the theatrical production process.

ABSTRAK

Kajian ini mengenal pasti dan menyiasat Bahaya Keselamatan, Kesihatan dan Alam Sekitar dalam Pengeluaran Teater Seni Persembahan Malaysia. Ia menganalisis dan mengukur kemungkinan dan keterukan bahaya terhadap kesejahteraan pengamal teater dan orang awam dan memastikan langkah-langkah untuk mencegah risiko. Penyelidikan ini penting kerana kekurangan peraturan semasa dalam industri teater seni persembahan Malaysia semasa beroperasi di bawah sumber terhad. Ia juga bertujuan membina data Keselamatan, Kesihatan dan Alam Sekitar untuk industri teater seni persembahan Malaysia. Pada masa ini, tiada penilaian risiko rasmi mengenai kerja-kerja pengeluaran syarikat pengeluaran teater kecil Malaysia. Apabila proses pengeluaran bermula dengan kerja pra-pengeluaran dan pengeluaran di luar teater, jurang dalam penyelidikan mengenai bahaya proses kerja ini ditutup menggunakan kaedah Pengenalpastian Hazard, Penilaian Risiko dan Kawalan Risiko (HIRARC) di syarikat teater Malaysia. Syarikat Malaysia yang dipelajari adalah sebuah syarikat teater yang mengkhususkan diri dalam produksi opera dengan ahli cast, orkestra, pekerja produksi, pereka dan kanak-kanak. Persembahan itu diadakan di sebuah teater yang terletak di Kuala Lumpur, Malaysia. Setiap fasa pengeluaran dikelaskan mengikut langkah kerja berpandukan lokasi, dan bahaya dikenal pasti. Setiap bahaya telah diberikan tahap risiko mengikut kemungkinan dan keterukan dan langkah-langkah kawalan dikenal pasti untuk mencegah risiko-risiko ini. Telah didapati bahawa kebanyakan risiko yang dihadapi di ruang latihan dan teater adalah sederhana, diikuti oleh risiko yang hampir pasti dan risiko yang tidak ketara. Di teater, peratusan risiko sederhana, hampir pasti dan tidak ketara adalah 64%, 35% dan 1% masing-masing. Di ruang latihan, risiko masing-masing adalah 80%, 19% dan 2%. Langkah-langkah untuk mencegah dan mengurangkan risiko ditonjolkan dalam bentuk cadangan untuk dikongsi dengan pengamal teater dan dilaksanakan dalam proses pengeluaran teater.

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Next, I would like to thank the Directors of the Kuala Lumpur City Opera, KLCO, Mr. Danny Chen and Mr. Ho Soon Yoon who graciously allowed me to conduct this research on one of KLCO's productions. Thank you for opening your doors and for your valuable insight into the practicalities of theatre productions in Malaysia. I admire KLCO's commitment to ensuring a safe and healthy environment for all those involved in its productions.

A heartfelt thanks also goes to all those who gave me their support in one way or other throughout this academic pursuit. Thank you for your suggestions, for checking in on me from time to time and for applauding every little milestone. I am glad our paths crossed.

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LIST OF SYMBOLS AND ABBREVIATIONS

ABTT : Association of British Theatre Technicians

CAD : Computer Aided Design

CCTV : Closed-circuit Television

CNC : Computer Numerical Control

CO : Carbon Monoxide

CO_2 : Carbon Dioxide

:

DPAC : Damansara Performing Arts Centre

FOH : Front of House

GWP : General Working Procedure

HIRARC : Hazard Identification, Risk Assessment and Risk Control

ISEM : Integrated Safety and Environment Management

JHA : Job Hazard Analysis

KLCO : Kuala Lumpur City Opera

KLPAC : Kuala Lumpur Performing Arts Centre

KOM : Kick-off Meeting

LED : Light-emitting diode

MSDS : Material and Safety Data Sheet

PEL : Permissible Exposure Limit

Penang PAC : Penang Performing Arts Centre

PPE : Personal Protective Equipment

TWA : Time Weighted Average

CHAPTER 1: INTRODUCTION

1.0 Background

Performing arts theatre genres differ from one geographical location to the next. Theatre genres in Malaysia range from the traditional Mak Yong and Wayang Kulit to modern plays. With migration, Chinese opera has grown in popularity, particularly in the Teochew language [1]. The advent of globalisation has even brought Western Opera to Malaysian shores.

The Kuala Lumpur City Opera (KLCO) was officially registered as Malaysia's very own opera company in 2015. KLCO now boasts of 15 principal singers and a resident chorus of 35 [2]. KLCO specialises in presenting Western Opera productions to the Malaysian public. KLCO produces at least two operas annually at performance venues such as the Kuala Lumpur performing Art Centre (KLPAC), Damansara Performing Arts Centre (DPAC) and the Penang Performing Arts Centre (Penang PAC). While shows to the public are carried out at these performing arts theatres, rehearsals may occupy various rehearsal venues such as the KLCO studio or other private venues according to the production budget and convenience of all those involved.

Involving more than one preparatory location, a typical opera production also consists of several phases. These phases are pre-production, rehearsals and production. The pre-production phase involves tasks such as planning, script sourcing, hiring of personnel, budgeting and arranging for performance venues. Rehearsals are made up of principal cast rehearsals, orchestra rehearsals, chorus rehearsals and combined rehearsals which are carried out at the rehearsal venue. Rehearsals for KLCO's productions are typically carried out at the KLCO studio before the company loads-in

at the pre-booked performance venue, such as KLPAC, DPAC or Penang PAC, about one week before the shows to the public. The production phase combines pre-production phase elements in preparation for the technical rehearsal. This technical rehearsal involves weaving together all elements of the show, including the desired stage lighting, sound and special effects at the performance venue.

The Malaysian performing arts theatre industry is thriving amidst shrinking corporate funding to allay high operating and maintenance costs. One of KLCO's performance venues, KLPAC, is an example of this scenario. KLPAC is located along Jalan Sultan Azlan Shah, Sentul, Kuala Lumpur. On 7th November 2017, the Malay Mail newspaper reported that KLPAC's ticket sales revenue was insufficient to cover its operating and maintenance costs. Therefore, until the year 2011, it enlisted the help of twelve corporate sponsors. Due to recent economic uncertainty in Malaysia, nine corporate sponsors withdrew their contributions. The resulting lack of funds has rendered KLPAC unable to make the necessary upgrades to its facilities [3]. This scenario in the Malaysian performing arts theatre industry points out the need to conduct a systematic study on the risks involved and measures to prevent them.

1.1 Problem Statement

Financial pressure faced by performing arts theatre might lead to infractions of existing safety guidelines in favour of protecting revenue. This is a critical issue as Malaysian institutions of higher learning continue to churn out Performing Arts graduates at Diploma, Masters and up to Doctor of Philosophy (PhD) level [4]. This gives rise to Performing Arts activities in Malaysia with possible increase in dangerous occurrences. Specific, proper and enforced regulations are needed for this sector in terms of Safety and Health to ensure that all performing arts employees and members of the public are not put in jeopardy due to performing arts activities.

Aside from the operation and maintenance of major theatres such as the KLPAC, the overall Safety, Health and Environment wellbeing of a specific theatre production can only be gaged if a review is conducted throughout the entire life cycle of a production. This is because the parties involved in theatre production work and other preparatory work begin carrying out their tasks outside of the performing arts theatre, much earlier than the date and time of the actual shows to the public. A risk assessment on the entire life cycle of a Malaysian theatre production is currently unavailable. There is also no comprehensive literature on Malaysian performing arts theatre safety. This research topic has been selected due to the lack of regulations on the Malaysian performing arts theatre industry while it is under immense pressure to operate with limited funding and poor revenue. This research study is also important to identify methods to improve the Safety, Health and Environment of Malaysian theatre productions.

1.2 Research Questions

Based on the research problems identified, the research questions to be answered are as follows:

1) What are the physical hazards faced by theatre practitioners and members of the public throughout the life cycle of a production?

2) What is the risk level of the various physical hazards faced?

3) What are the steps that can be taken to reduce the likelihood of physical hazards faced?

1.3 Objectives

This research study is aimed at identifying, understanding and preventing the Safety, Health and Environment Hazards in a Malaysian Performing Arts Theatre Production. The research study will analyse and quantify the likelihood and severity of physical hazards on the well-being of theatre practitioners and members of the public. It will also identify measures to prevent the risks.

The objectives of the study are:

1. To identify the hazards in a Malaysian performing arts theatre production.

2. To conduct risk assessments on the hazards identified in a Malaysian performing arts theatre production.

3. To propose preventive measures for the hazards identified in a Malaysian performing arts theatre production.

CHAPTER 2: LITERATURE REVIEW

2.0 Overview of performing arts theatre

Performing arts may refer to a wide variety of performance genres such as operas, plays, film, the circus and live bands. However, all types of performing arts are made up of pre-production, rehearsals and production phases. Therefore, for the purpose of this review, performing arts theatre is studied to identify typical Safety Health and Environment hazards general to all forms of performing arts.

Performing arts theatre productions are divided into two major phases which are pre-production as well as production and rehearsals. Each phase contains an array of departments and parties who work independently and form close collaborations in order to execute a theatre production[5]. The pre-production phase consists of script sourcing, personnel selection, fund raising, location booking, insurance, operations and financial management, contract preparation and artistic visualisation. The production and rehearsal phase consist of the technical rehearsal, dress rehearsal and performances. The roles of each unit in each phase are explained in detail in the following subsections.

2.1 Pre-production Phase

The Producer does the preliminary work of script sourcing, director selection, casting approval and fund raising. He works with theatrical agents and unions, books the theatre venue for performance, rehearsal space, and handles insurance with regards to the show. The producer also hires the Production Team which is typically made up of a General Manager, Production Manager, House Manager and Stage Manager. Aside from the Production Team, the Producer also hires accountants and legal representatives [6].

Pre-production also involves the selection of a design team, as well as choreographer and / or fight director. Presentations are made by the director and design team to the production department and stage management to quantify the workload of the production in question. Having a clear picture of the workload provides a realistic forecast of the number of personnel required to carry out the various tasks. This phase is primarily made up activities by the Theatre Administrator, Artistic Director, Production Manager and Technical Director [5].

The Theatre Company Administrator and General Manager generally focus on operations and financial management. They are in charge of negotiating royal fees required to perform copyrighted work, prepare contracts for those all those involved in productions, establish an avenue for ticket sales and publicity. These roles also prepare the production financial budget, arranges auditions for potential cast members and obtains official approval from authorities for safety and health. The Artistic Director sets the artistic visualisation of the show and selects actors, director and design team who will work on the production. He drives the production's direction and may initiate educational programs, tours, collaborations and commissions with regard to the show [5].

2.1.1 Set Design and Construction

The pre-production phase begins with Design. The selected set designer obtains the show script and officially meets the Director for a briefing on his intended concept of the play. Based on this initial meeting, the director and designer develop the design concept. The script is then broken down to identify the number of characters, theme, setting, period, size and capabilities of the chosen theatre, audience appeal and how best to present story. Thorough research is carried out on all aspects of

the play that culminates to a Design Meeting with all departments to discuss the way forward [6].

The Designer then drafts a scaled drawing of the stage either manually or using computer aided design (CAD) software. The designer provides visual concepts of the design and is not responsible for its structural integrity, engineering, rigging and handling. The design drawing must indicate a liability disclaimer to this effect and include a statement that all legislation with regard to fire and safety codes must be followed [6].

Once the stage drawings are available, complete colour rendering or models are then built by the set designer. These drawings will be sent to the designated financial controller for approval to proceed to execution. The designer and his assistants develop the drawing pack (stage drawings, cover sheet with index, sketch, photo of models, ground plan, section, deck plan, elevation etc.). The designer decides on the level of detail required in the drawings that are to be handed over to the scene shop [6].

As the designer assumes no liability for the structural integrity of the finished structure, the best design control is that a Structural Engineer should be consulted prior to translating the design from drawing to construction. Appropriate approval from local authorities should also be a part of the final design process to ensure structural integrity. Appropriate drawing revisions should be made necessary prior to construction. It is also necessary that theatre companies maintain a Legal Register of all applicable codes and standards with regard to design, and also other areas related to the business and welfare of all parties affected by its activities.

When the stage design drawing pack reaches the Scene shop, scenic activities begin with a thorough evaluation of the drawing pack. The scene shop then prepares a

proposal with cost estimate for sharing with its client, the Theatre Company executing the production. The Theatre Company then accepts or rejects the proposal. If the proposal is approved, the scene shop proceeds to create a job order and schedules a kick-off meeting (KOM) with all its departments for alignment. The Designer and Technical Supervisor are also invited for the KOM [6].

Once alignment between departments are clear, a realistic Project schedule is created based on a flowchart from the stage and set construction phase until transportation to the theatre. The schedule takes into account material availability, duration to carry out specific work and availability of suitable personnel. Items that would require the attention of more than one department are also identified so that all work can be carried out efficiently [6].

The Engineering department creates construction drawings that break down the design drawing s into individual manageable pieces for final assembly at the theatre. A Draft of required automation and appropriate control systems as well as development and planning of set electrics are also prepared. The Engineering department also carries out research on new technical products that would suit the production [6].

Once engineering drawings are complete, these drawings are sent to the Carpentry department and Iron department for woodwork and metal work. Both woodwork and metalwork require measuring, cutting and fabrication. More advanced scene shops have the capability to develop CAD drawings for upload into a Computer Numerical Control (CNC) router that automatically cuts wood in the required dimensions. Metalwork also involves steel welding as well as aluminium welding [6].

Complex stage design may also require automation. The Automation department looks into set items that move on the deck as well as flying elements. The Electrical department also plays a role in ensuring proper set automation wiring

besides their usual scope of set in-built lighting and wiring [6]. An example of specialised complexed automation was in The Metropolitan Opera's Wagner's Ring Cycle. The set machine for Robert Lepage's Ring Cycle at the Metropolitan Opera, weighed approximately 45 tons [7]. The set machine comprised two towers, attached to a level-adjustable axis. The axis was attached with 24 adjustable planks that could be controlled to seesaw into various configurations for aesthetics and special effects on stage. Virtual scenery was projected on to the planks surface with sophisticated computer technology. A server room was constructed specifically to house the controls needed for the machine. Most of the acting took place on a platform in front of the machine [8].

Traditional set design employs the Scenic art department to develop sketches and samples for approval by the designer. Once approved, the constructed set is sent for painting based on the samples created. Soft material and other equipment that are not built or bought for the production may also be rented by the Rental department. The Trucking department does the final step of truck loading and transport of the finished set to the theatre. The Trucking department also moves large items to appropriate locations in the theatre for on-site finishing [6].

2.1.2 Costumes

The Head of Costumes or Costume Designer has a primary role in ensuring Costume workshop safety and health. He also ensures that the workplace is arranged in a practical manner for work execution. The Head of Costumes is heavily involved in managing Costume staff, planning and scheduling of Costume design and preparation, preparing a cost estimate for the desired output as well as managing supporting costume sections [5].

The Costume designer liaises with the director and design teams to have a clear view of the costume requirements of the production. He is required to participate in production meetings and presentations to know the latest updates from the various production departments that may affect costume selection. He also interacts with cast members during the process of obtaining costume measurements and fittings [5].

Akin to designers in the other departments, the Costume designer is required to study the production script. He is also required to researches the period for which the show was composed to have a clear understanding on the type of style to apply in his designs. He is also in charge of procuring the required material for constructing the costumes within the allocated production financial budget [5].

2.1.3 Lighting and Sound

The Lighting designer and Sound designer study the script thoroughly and work closely with each other, the director, set designer and costume designer on lighting and sound requirements that complement the artistic direction of the show. They participate in production meetings and presentations as well as observe rehearsals. Attending these meetings give them the latest requirements and updates with regard to production lighting and sound. Once the lighting and sound design requirements are sufficiently mature, they select appropriate lighting and sound equipment. The Head Lighting Designer and Sound Designer would manage a team of staff each to assist them in the various design activities [5].

2.1.4 Music

The Musical Designer and Director are required to compose music for the production. The first step of his work is similar to all other departments in that he needs to conduct a detailed study of the script. His composition will be based on intensive discussion with the overall director and design team. The process of composition also involves selecting the appropriate equipment and musical instruments. He is also responsible to buy or rent the equipment selected. Once the composition is finalised, the Musical Director has to plan and schedule for rehearsals studio recordings with his team of musicians. He is also required to participate in production meetings so that he is aware of the latest production developments [5].

2.1.5 Special Effects and Projection

Special effects design is to be carried out in a safe manner by experts, in collaboration with the Sound and Lighting departments. There are a variety of special effects used in the present theatre industry. These include artificial lightning produced by strobes and projections, artificial thunder produced through collaboration with the sound department, actual fire that requires execution by a person with a special licence as per local regulations as well as simulated fire using lighting, properties sand pre-packaged units that can be plugged in [5].

Artificial rain is created using a stage deck with an in-built drain, with overhead plumbing to release rain drops. The water temperature is controlled so that it is not too hot or cold for the safety of actors. Artificial rain that is captured by the stage drain drainage is recycled back into the overhead plumbing system to generate more rain. Artificial snow is generated using a snow machine and special snow fluid.

A fog machine is used to produce artificial fog using water soluble fog fluid or dry ice [5].

Projection design is done in close collaboration with the scenic and lighting departments. Once the artistic direction of the production is clear, the first step in projection design is to generate a projection Equipment List. Typical equipment on this list would be various types of projectors and Light-emitting diode (LED) lighting boards. Once the equipment list has been finalised, the Projection department coordinates shipping, transport, installation of computers and projection equipment, as well as the technical support needed at all stages of projection. The Projection designer also creates a storyboard of images that will be projected to serve a reference [5].

2.2 Production and Rehearsal Phase

The production phase comprises the technical rehearsal, dress rehearsal and performances. This phase starts when all pre-production elements are put together in preparation for the technical rehearsal. Along with pre-production roles that will move into the production phase, new personnel also come into the picture at this point [9].

2.2.1 Stage Manager

The focal point of production management is the Stage Manager who ensures that all departments are aligned in terms of schedule and using the most updated information. The key forms and documents prepared by the Stage Manager include Audition forms, list of Contact details of all, rehearsal schedule vetted by the Director and sign in sheet for rehearsals [6]. The prepared Rehearsal schedule also calls on production team and cast members to read through relevant safety notices and precautions [5].

The Stage Manager compiles daily rehearsal report on the activities of all parties involved in the production. He is in charge of disseminating these reports to all affected departments so that each one is aware of the latest developments. As he generates the reports, he is also required to provide clarifications to the various departments on Clarify on the items captured in them [6].

To sufficiently dissect the script, the Stage Manager carries out a French Scene Breakdown. A French Scene breakdown is a spreadsheet containing all the scenes in the production with mapping to the list of characters involved in them. He also notes down the blocking of movement on the stage and continuously updates it if there are changes following rehearsals. Additionally, he prepares breakdown lists for properties and costumes to keep track of the many props needed for each scene and for sending to the costume designer for verification respectively. The costume breakdown list is also important to ensure that ensure fitting is carried out on schedule [6].

In order to ensure discipline among the cast members and crew, the Stage Manager establishes a policy on tardiness as deemed necessary by the Director. The Director also dictates the final blocking of curtain call sequences. Last but not least, the Stage Manager is heavily involved in Safety and Health at the theatre. He is in charge of filing Accident Reports of every accident that occurs throughout the production [6].

2.2.2 Light Operator and Sound operator

The light operator and sound operator are charged with checking all sound and lighting equipment prior to shows. During shows, they receive cues from the Stage Manager as to the precise moment to initiate a particular lighting or sound effect [9].

2.2.3 Costumes

The Costume Designer manages the staff working under him at the theatre. He also liaises with the director and other design teams to get an overall view of what the production is all about. The Costume Designer also prepares costumes that are to be worn by the cast on their show days [5]. Additionally, the Costume Runner helps to prepare the cast members when costume changes are required while the show is going on [9].

2.2.4 Property Master and Running Crew

The property master enlists the help of the running crew at backstage of the theatre. He acts to ensure that all the props are at its designated position before, after and during the show [9].

2.2.5 House Manager

The House Manager is primarily in charge of selling tickets and ushering patrons. He is usually employed by the theatre and is therefore in charge of theatre building maintenance. However, during the production period, he works closely with the production management team [6].

2.2.6 Dance and Fight Sequences

After a comprehensive review of the script, the Choreographer schedules sufficient dance rehearsals with the dancers involved. He choreographs and directs movement sequences to fit the requirements of the show. The choreographer is also required to participate in production meetings so that he is up to date with production issues that may impact his choreography. He also provides advice on the required properties for his choreography [5].

Productions that have fight scenes might employ a dedicated Fight director to plan the fight sequence. The fight director designs and directs fitting movement sequences based on script content and the artistic direction of the show. He then schedules fight rehearsals with the actors involved. The fight director provides advice on the required properties or weaponry to complement the fight sequences of the production. He is also required to attend production meetings to stay abreast with latest production developments [5].

2.3 Theatre Equipment and Technicalities

The various departments involved in production do not start working under one roof. Design work is carried out at the respective design studio or office while set Construction is carried out at dedicated workshops. Preliminary rehearsals by cast members take place in separate rehearsal studios as the theatre will only be booked about one or two weeks prior to the show date. The various departments then come together at the theatre to combine their work into the final production. The combined work is seen for the first time in the Technical and dress rehearsals that are carried out at the performing arts theatre.

The theatre contains many types of equipment to enable a successful production. All modern day theatres come with a dedicated theatrical rigging system. Theatrical rigging comprises line sets which are individual rigging points from which lines are hung from the theatre ceiling. The theatre is required to keep a line set inventory to map line positions relative to a plaster line. There are five main types of theatrical rigging systems. These are the hemp house, single purchase, double purchase, counterweight assisted winch system and fully motorised winch system [6].

The hemp house is a manual system made up of rope, organic or synthetic lift lines. These lines require counterweights at the other end of the line to balance the load that is being lifted. A pin rail is a locking device used to prevent the lifted object from falling. Pulleys for the ropes are known as sheaves while an assembly of pulleys is known as a block. There are various types of blocks including the spot block which is a temporary connection to a theatre structure, head block which is a pulley mounted on to steel above the theatre's fly loft to change direction of multiple ropes and the loft block which is a pulley mounted to a gridiron that changes the direction of rope between the head block and load. The block and fall is equipment similar to a standard block. It reduces multiple ropes than go in through its top to one rope that comes out through its bottom for easy manoeuvring. A dead lift refers to the act of lifting without using counterweights. In a hemp system, the rope goes through the loft block, then through the head block and through the pin rail [6]. Figure 2.1 shows a Hemp House system.

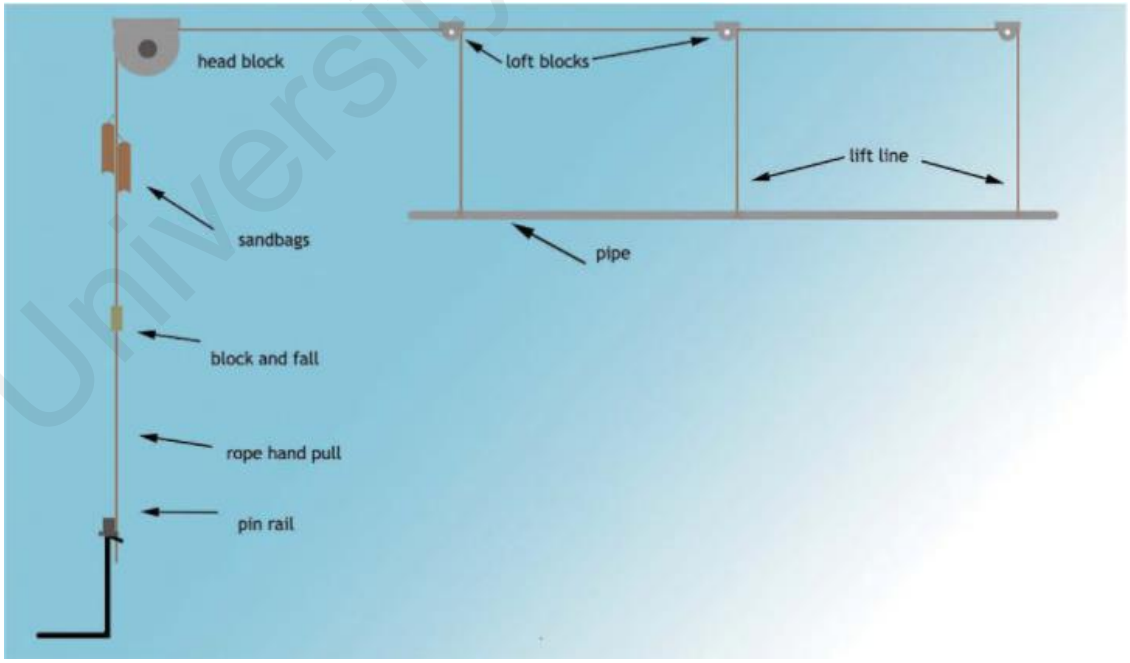

Figure 2.1: Hemp House [6]

A single purchase system is also a manual system. However, its lift lines are made of wire rope. The rope is bent around a grooved fitting called a thimble for support, kinking reduction and wear reduction. A wire rope clip is used to secure the thimble. The single purchase system comes with an arbor which is a rack that contains weights called pig iron. The loading floor is the stage floor, where technicians add or remove counterweights, usually at the lowest level of the pipe. The single purchase system takes up significant stage space. The ratio of counterweight required to the load to be lifted is 1:1. The wire rope goes through the loft block, followed by the head block and through the arbor. A hand pull is a synthetic rock attached to the bottom of the arbor and goes up to the head block. It can be pulled to change the elevation of the pipe [6]. Figure 2.2 shows a Single Purchase system.

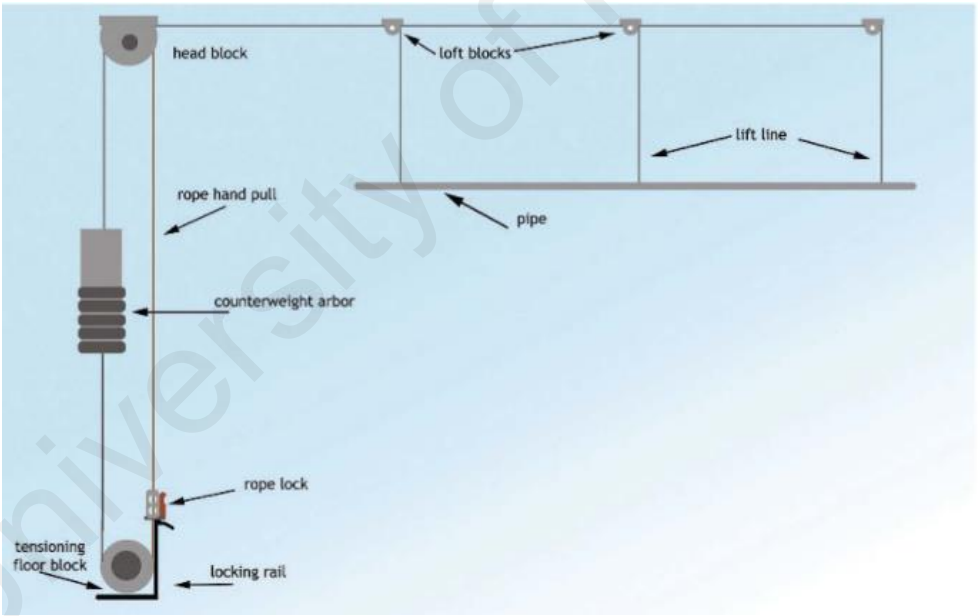

Figure 2.2: Single Purchase system [6]

The double purchase is a manual system as well. Its loading floor is located half way between the stage floor and loft floor. The benefit of the double purchase system is that it does not take up stage space. It has an extra pulley above and below the arbor, compared to the single purchase system. The ratio of required

counterweights to the load that required lifting is 2:1 [6]. Figure 2.3 shows a Double Purchase system.

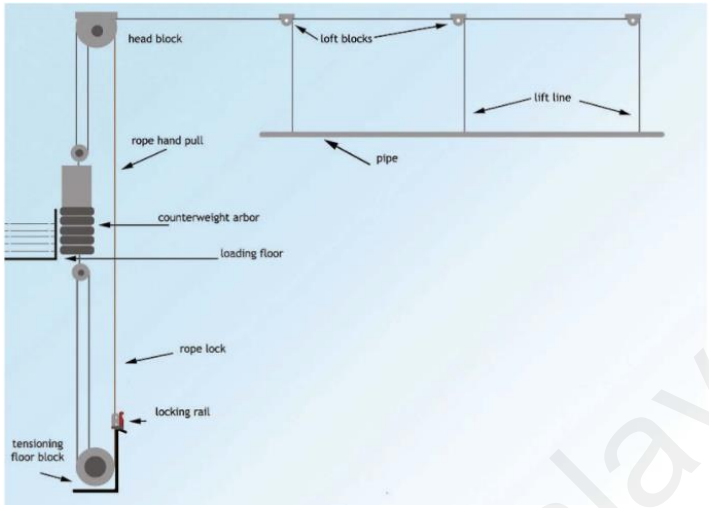

Figure 2.3: Double Purchase system [6]

The counterweight assisted winch is an automated system. A winch refers to a gear mechanism that is used to raise or lower objects. It is retrofitted into an existing manual system that uses counterweights. Once the counterweight assisted winch is in operation, the counterweights do not need to be readjusted. The counterweights used need to be rated at 50% of maximum set capacity. The winch also needs to be rated at 50% of maximum set capacity [6].

The fully motorised winch system is also an automated system. It uses a single drum winch which has a loft block and head block similar to the manually operated counterweight system. It comes with a line shaft winch that has a line for each lift line with no need for blocks. The main disadvantage of this type of rigging system is that it is expensive [6].

Performing arts theatres are also equipped with trusses. A truss is made up of pipes that are fabricated together with cross bracing. A truss is used to replace pipes when the load to be lifted is too big or when there is a big distance between lift lines.

The truss is made of aluminium tubing, has truss wheels for smooth movement, and carries two lighting bars located inside it as well as and lanterns [6].

There are several safety measures that can be taken to reduce the risk of dangerous occurrences due to frequent human-machine interface. The ProPlus Rescue system can be mounted on the theatre grid, rigging steel or truss for assisted rescue of personnel working at a height [10].

The Safety measures required at the theatre would be to ensure proper equipment installation, and regular inspection while the equipment is in operation and also a routine inspection every six months. Operator alertness also plays a significant role in mitigating incidents that to occur.

2.4 Overview of performing arts disasters

Theatrical disasters occur due to technological failure and administrative failure. As theatrical technology advances, more types of complications have occurred. The complications in theatre range from minor complications whereby the shows still went on to loss incurring complications whereby the show had to be cancelled. Major performing arts disasters are discussed in the following section to provide an overview of the impact, causes, consequences and overall seriousness of theatrical disasters towards the well-being of people and property [11].

The following subsections elaborate on a few performing arts disasters that have occurred in different genres. Table 2.1 shows a summary of performing arts disasters.

Table 2.1: Summary of Performing Arts Disasters

No	Year	Location	Genre	Production	Disaster	Impact
1	1982	National theatre, London	Play	Way Upstream by Allan Ayckburn	1) Water leakage onto the stage and electrical equipment, 2) Artificial rain spread until row A of the audience. 3) Set manoeuvring failure onstage.	1) Electrical supply to the entire building was compromised and two previews were cancelled. 2) Audience were drenched in artificial rain 3) Onstage collision and compromise in structural integrity of the stage set up.
2	1939	Los Angeles, United States	Film	The Wizard of Oz	1) Application of aluminium powder on the "Tin Man" who was supposed to be made of tin.	1) Two weeks of hospitalisation due to an allergic reaction to aluminium powder.

No	Year	Location	Genre	Production	Disaster	Impact
3	1944	Hartford, Connecticut	Circus	Hartford Circus	1) Fire that spread through roof pole coated with paraffin and gasoline for waterproofing	1) 167 fatalities
4	2003	Rhode Island, United States	Live Band	The Station Night Club	1) Fire due to the band's pyrotechnics that lit up soundproofing foam behind the stage.	1) 96 fatalities 2) 187 people were injured

2.4.1 Play: Way Upstream, 1982

Way Upstream was a play by Director, Allan Ayckburn that was staged at London's National Theatre in 1982. Severe complications arose from its staging due to the technical complexity of the show. An actual boat was used for staging the play on a flooded stage in theatre. The boat on onstage housed actors and crew members while

moving through the stage in artificial rain. The boat underwent violent swivelling while due to poor technical management [12].

According to Staging Notes by Allan Ayckburn, the boat intended had to meet technical requirements for resilience against other staging elements. It had to be water proof against artificial rain and appropriate control measures were required for uneven weight distribution. It also required adequate lighting for visibility from both the audience seat and from crew members for clear artistic ques. The boat was to be fit for gentle movement as well as turbulent movement on stage [12].

For the purpose of good aesthetics, Way Upstream used black sheets to block the boat's doorway. An artificial recording of the boats engine sound was used during boat movements for a better presentation to the audience. The artificial engine sound may have deterred onsite technicians from detecting engine problems in the boats actual engine [12].

A summary of stage dossiers and notes from Ernest Hall, the Stage Manager stated that severe mishaps occurred during set-up as well as the actual shows. The boat was housed on stage in a water tank. During set-up, leakage from the water tank damaged the stage and compromised the electrical supply of the entire building. As a result, two previews of Way Upstream were cancelled [13].

Different productions need dedicated Safety Reviews to assess if additional control methods are required for safe execution. In productions that would require a water tank onstage, emergency flood measures need to be developed to ensure that there is a clear plan of action in case of water tank leakage in the theatre. Such flooding would also give rise to the possibility leaks into the stage elevator cavity, inflicting damage on the mechanics of stage elevators, electrical equipment and personnel safety (due to impact of falling objects and electrocution).

A series of technical mishaps continued during the actual shows when the boat collided with its artificial bank, causing its brakes to malfunction. The show was halted to make the necessary adjustments. When the show resumed after eighteen minutes, artificial rain that was supposed to be limited to the stage, spread until row A of the audience. On a separate show, the artificial bank that was moving on stage had to be un-jammed due to a faulty pivot winch. On all occasions, the actual shows continued with only two previews cancelled [13].

Besides the boat and artificial bank, there were also issues with the water tank that was used to house the moving boat on stage. Tests on the water contained within the tank by the Department of Microbiology of St. Thomas Hospital found that it posed a threat of gastroenteritis to personnel who come into contact with it. As a result, the water tank was used without water. There are reports that a hole developed in the tank due to a fire that occurred while it was in storage [13].

The severe technical compromise that occurred during the set up and running of Way Upstream at the National Theatre had its root cause in Administrative failure. Due financial constraints, the theatre administration chose to not hire Structural Engineers to design the set. Set design was done entirely by metal workers as they built it [14].

The total weight of the boat and set with personnel on board was underestimated. The moving artificial banks that were originally intended to weigh 0.5 tonnes weighed 1 tonne due to oversizing of wood work. The wood work was to complement the set's metal work. This oversizing was due to a failure in synchronisation between the metal work and woodwork department. Further investigation found that this failure was due to the carpenter's preoccupation with another production's set design. There was also no proper design interface

coordination between the metal works department and the weight estimator. The underestimated weight also did not take into account that two winch operators and stage directors had to be on board the boat together with the actors for cues [14].

The consequences of breakdown in inter-department working schedule interface shows that a theatrical production requires a set design interface coordinator for complex productions. All parties such as the Structural Engineer, Weight Estimator, metal works department, carpenter, artistic committee and Cost Estimator should have regular status meetings. Although this coordination is typically carried out by the Stage Manager, it is clear that a dedicated person should be hired for Interface Coordination of a technically complex production.

The manoeuvring of the boat on stage was anchored by winch cables. Indication markers were placed on the cables with tape that moved from the intended marking point due to friction against the artificial bank. Inaccurate marking caused mishandling of the boat. This led it to eventually collide against the bank, further compromising the integrity of the water tank due to vibration. Set lighting was also damaged [14].

The Way Upstream production at the National Theatre in London was also bogged by Administrative failure. The Production team was not adequately briefed on technical support or emergency procedures at the theatre. The default theatre representative who was supposed to be the focal point for these matters was away on a business trip without communicating the contact details of his replacement [14].

2.4.2 Disaster in other Performing Art genres

Safety lessons learnt from other art forms are also relevant in a review on theatrical safety. This is so that a comprehensive picture can be painted on overall safety issues in performing arts which that can be further analysed from a theatrical perspective. The following paragraphs describe prominent disasters that highlight the importance of prioritising safety in performing arts.

2.4.2.1 **Film: The Wizard of Oz, 1939**

The making of the film, The Wizard of Oz in 1939 saw the actor, Buddy Ebsen hospitalised for two weeks due to an allergic reaction to cosmetics. Ebsen intended to play the role of the Tin Man, who is essentially a man made out of tin. As such, the make-up artists set out to apply aluminium powder on the actor's skin to simulate the appearance of a body made of tin. A severe allergic reaction to aluminium developed and he was sent to the hospital for treatment. Another actor replaced him as the Tin Man with alternative make up [6].

Safety in performing arts is also influenced by exposure to hazardous chemicals during production. The example of Buddy Ebsen in The Wizard of Oz highlights the need for a mandatory health declaration of actors who apply to be cast in productions. The reason is so that specific allergies would be known to the Stage Manager who can then cascade this information to the relevant departments for incorporation in their various deliverables such as cosmetics as well as set design and construction.

2.4.2.2 Circus: Hartford Circus Fire, 1944

A fire broke at the Hartford Circus in the year 1944 in Hartford, Connecticut. A fire had started which reached roof pole coated with paraffin and gasoline for waterproofing. The flammable paraffin and gasoline coats caused the fire to split into three directions. The traditional Disaster March was played to help theatre personnel organize the audience' exit without panic [6].

The disaster occurred in the afternoon of 6th July. There were 167 fatalities. When the fire was re-investigated in 1993, the cause of ignition was deemed undetermined due to a lack of solid evidence. However, it is known that the fire started at the men's room tent. Due to obstructed visibility of the men's room from the big top where the show was going on, the fire went unnoticed until it had spread from the ignition point, to the men's room canvas walls and subsequently to that of the big top at various levels [15].

The canvas walls used at the circus were not fire proof. Seatmen who were employed by the circus to put out fires did not notice the fire until it had spread from the flammable canvas walls to the roof canvas which was even more flammable due to its paraffin coating for waterproofing. The Seatmen who were on duty under the bleachers did not notice the fire until they heard cries from circus patrons. By this time, the fire had spread to the roof. Once the fire hit the roof, protocol was to evacuate the area as basic firefighting by Seatmen would have been insufficient to put out the blaze. A gust of wind further exacerbated the fire by carrying burning wax coated canvas to land on fixtures [15].

Construction material of the circus tent walls and roof was flammable and this was known by circus personnel. The control measure in place to prevent the spread of fire in the already hazardous building structure was to employ personnel to look out

for fires and put them out using buckets of water placed under their seat. Human intervention was the only fire prevention measure. Where human intervention is the only defence against unsafe occurrences, proper planning, enforcement and mandatory guidelines are necessary to ensure effective monitoring and mitigation of hazards.

2.4.2.3 Live band: The Station Nightclub, 2003

A fire broke out in the year 2003, at a nightclub in Rhode Island, United States. The attending band's performance pyrotechnics lit up soundproofing foam behind the stage. Spectators did not realize the blaze was uncontrolled until the fire reached the ceiling. Post disaster simulations concluded that a sprinkler system would have effectively put out the fire.

There were 96 fatalities and 187 people were injured. The fire spread rapidly from the soundproofing foam to nearby panelling and a low hanging suspended ceiling. Investigations show that although the club underwent routine inspection two months before the blaze, the club or band did not obtain an official fire permit for a pyrotechnics display. Although the band claimed that the club was informed of the intended display, club management insists that they were not notified and hence did not file an application for a fire permit [16].

Obtaining the necessary approvals by law for special effects involving fire is crucial in ensuring that the resulting display would be carried out safely. The process of obtaining a fire permit would have ensured that appropriate hazard identification and control is carried out at the planned area for the specific show. The absence of a sprinkler system could have been identified and fixed as a condition for releasing a fire permit. Formal channels of notifying show plans to the necessary parties are also

necessary to avoid organizational communication breakdowns. These communication breakdowns might inadvertently lead to disasters such as The Station Nightclub fire.

2.5 Safety, health and environmental hazards in theatrical productions

Before reviewing the Safety, Health and environmental hazards at various phases of theatre productions, it is necessary to clearly define hazards and related terms. A hazard is a condition with likelihood to cause harm such as death, ill health and human injury, property damage, product damage or environmental damage. Hazards cause business loss, production loss and increased liabilities. A major accident has the potential to kill three or more people or cause damage to the environment and property in excess of a defined sum. Minor accidents are accidents that cause ill health while incidents refer to undesirable circumstances and near misses that have the potential to cause accidents. Finally, a near miss is a situation with potential to cause major harm [17].

The rationale for reviewing hazards associated with various phases of theatre productions is to thoroughly identify hazards based on specific job steps in those phases. This builds the basic framework for conducting a Job Hazard Analysis (JHA) which is an efficient way to identify and control safety, health and environment hazards in theatre productions. The University of California carried out a JHA on specific tasks by the various departments involved in its performing arts activities to produce clear guidelines Safe work practices. The university also used the ISEM (Integrated Safety and Environment Management) five core values as a guideline for hazard analysis, control and mitigation as outlined in its Safety and Health Policy [18]. The core values of ISEM are as follows [18]:

1. Define the Work or Activity

2. Analyse the Hazards

3. Develop and Implement Hazard Controls

4. Perform Work or Activity

5. Review and Provide Continuous Improvement Feedback

The official Guidelines for Hazard Identification, Risk Assessment and Risk Control (HIRARC) by the Department of Occupational Safety and Health Malaysia, states that the process of risk identification employs the use of inspection, JHA, failure analysis and incident investigation [19]. General safety, health and environmental hazards at various phases of production are comprehensively reviewed according to specific job locations below.

2.5.1 Chemical hazards

The Scenic art department workshop houses a wide variety of chemicals that are used in the painting process. The Scene shop ensures that the Material and Safety Data Sheet (MSDS) for all substances are kept at the shop for easy reference in case of emergencies and to prescribe appropriate control measures against chemical hazards at the work area [6].

Chemicals may lead to physical ailments as well as fire. Generally, all containers containing mixtures should be labelled with a list of its components. Allergic reaction to latex is mitigated by enforcing the use of gloves made of vinyl for hand protection. Fire prevention begins with storing flammable chemicals and combustible products in a metal cabinet. Fire is further prevented by eliminating the usage of fire accelerants such as metal flakes or by substituting it with a non-

hazardous option. In order to ensure proper flame retarding of finished scenery, a flame certificate should be obtained and kept as part of official records [6].

2.5.2 Personal hazards

There are a wide variety of physical hazards at the theatre. Personal Safety Hazards at the theatre starts with personal attire. Loose clothing may get caught in power tools, tight clothing may restrict movement while insufficient clothing may expose the skin to splinters and infections due to occupational chemicals. Therefore, theatre personnel are to ensure that their clothes are a good fit prior to entering the theatre [6].

Jewellery and long hair that is not pulled back may get caught in power tools. Therefore, theatres should ensure that any jewellery worn during work is small or removed completely and long hair should be secured. Long hair can even catch fire if it comes into contact with flammable substance and an ignition source [6].

Flimsy or uncovered shoes may cause foot injury due to stepping on sharp objects such as nails at the work area. Wearing steel boots at the theatre may be counterintuitive as steel boots may worsen injury in the instance of crushing. Therefore, it is good practice to simply ensure that work shoes are sturdy and fit for the job at hand [6].

Frequently, shortcuts are taken to save man-hours and time amidst a tight production schedule. Severe compromise in safety might occur if such shortcuts are taken during Load in & Load out of the set at the theatre as there will be a high traffic of large items and equipment going into the theatre for set up. Therefore, safety procedures must be adhered to even during peak work levels at the theatre [6].

2.5.3 Special effects hazards

Hazards may arise from the production use of special effects. This includes artificial elements such as fog, and smoke as well as flame effects such as pyrotechnics and explosives [20].

The fog fluid used in fog machines is hazardous if not used correctly. The fog fluid has to be kept away from strong oxidizing agents and strong acids as it is highly reactive when it comes into contact with these substances. Handling of fog fluid requires special personal protective equipment (PPE) based on the Material Safety Data Sheet (MSDS) from the supplier. Decomposition of the fluid could release carbon monoxide (CO) and carbon dioxide (CO2) [21].

2.5.4 Set and Properties hazards

Set and props used in the production have individual hazards that need to be analysed on a case by case basis. General hazards are the misuse of props or costumes, handling of weapons and moving scenery due to installation or disassembly, automation, scene changes, and set changeover [20]. During a production of The Ring Cycle by the Metropolitan Opera, Mezzosoprano, Jennifer Johnson, who was playing The Rhinemaiden was almost crushed by the automated set machine. Alertness and effective communication by the Stage Hand enabled quick human intervention to pull her to safety. Productions or Theatre houses should also ensure set inspection by a competent engineer so that hazards can be identified and human-set interactions minimised if necessary [22].

2.5.5 Auditory hazards

Excessive sound levels could occur due to high volume of music or the operation of power tools. An evaluation of the noise exposure of symphonic orchestra musicians found that noise level exposure of symphonic orchestra musicians are higher than the Action Level of 85 dBA over Time Weighted Average (TWA) of 8 hours. The percussion section is typically exposed to peak noise levels of 135 dBC [23]. The Factory and Machinery Act 1967 allows impulsive sound not higher than the Permissible Exposure Limit (PEL) of 140 dBA [24].

The effects of noise caused by power tools in operation can be reduced by wearing appropriate personal protective equipment such as earplugs and ear muffs. Power tools that cause high levels of noise include the power saw, power drill, air compressors, grinders and welders [6].

2.5.6 Tripping and falling hazards

Tripping hazards may occur due to unequal stair elevations, raked floors, and unsuitable floor surfaces, especially for dance and fights. Obstructions caused by the set, properties and cables backstage could also pose a tripping hazard due to low visibility during the performance, technical rehearsal or dress rehearsal. The backstage area is usually blacked out once the performance is about to begin. Cast members' possible headgear could also be a tripping hazard as it has the potential to obstruct vision [20].

With theatrical rigging systems, the theatre has significant falling hazards from high elevations. Personnel could fall off edges of balconies without safety railings and off of raised up set pieces. One could also fall off the stage into an orchestra pit or

stage trap. Certain productions may also require cast members to fly during the show. Said cast member may fall if technical complications occur while flying [20].

2.5.7 Competency and preparedness hazard

Hazards may occur due to a lack of training or certification of personnel on-site. This has to do with both cast and crew. Adequate technical prowess is necessary to safely operate theatrical rigging systems, handle fire arms, and pyrotechnics. A lack in competency may lead to serious accidents at the theatre such as falling from high elevations, fire and electrocution. Unpreparedness to face emergencies such as power failure, emergency access, egress or evacuation is also a hazard towards cast members, crew as well as the public who attend the show [20].

2.6 Malaysian performing arts theatre production Regulation and Policy

Unlike in the United Kingdom and Europe, Theatre Technicians in Malaysia are not required to have a specific certification in performing arts theatre. There is no available guideline by the Malaysian Department of Safety and Health to govern the qualifications required by Theatre Technicians. This leads to compromise in the Safety and Health of theatre workers and theatre goers especially in cases of emergency where onsite technicians are not formally trained to deal with the situation [25].

Aside from not having laws to govern the qualifications required by theatre technicians, Malaysia also has lack of expertise who can deal with theatrical technical issues. There are instances reported by local stage managers where Technicians have had to run back and forth between different productions to handle technical issues [25].

There has been effort made by Yayasan Sime Darby to provide formal training for Theatre Technicians in order to fill this void. The trainers for this workshop are from the Association of British Theatre Technicians (ABTT), London. Participants who complete all four days of training successfully will receive the certification of ABTT Bronze Malaysia. The modules in this training include various guidelines in different sets of Malaysian legislation that may apply to performing arts theatre [25].

There should be a requirement to make it mandatory for all theatre technicians to undergo training and obtain certification. The current climate in Malaysia is that optional training is available and theatre houses may opt to impose requirements on the personnel hired as technicians. This should be encapsulated in the yet to be developed official legislation on performing arts venues in Malaysia. Examples used in the United Kingdom and Europe may be used as a reference and adapted to suite local requirements. However, to ensure that the current local scenario is properly captured for consideration when adapting international laws to Malaysia, a case study on the Hazards and Risks posed by a Malaysian produced production in a Malaysian theatre should serve as the starting point.

CHAPTER 3: METHODOLOGY

3.0 Methodology

This research took place in several locations used by cast members of a Western Opera, The Marriage of Figaro, produced by the Kuala Lumpur City Opera (KLCO), a local Malaysian performing arts theatre company. The reason why KLCO was chosen as the preferred theatre company is because production of The Marriage of Figaro covered a wide range of performing arts such as acting, singing and orchestra. The production also involved adults as well as children. Furthermore, the actual performance by KLCO was held at the Kuala Lumpur Performing Arts Centre, KLPAC, on 12th, 14th and 15th of October 2017. KLPAC has been struggling financially to operate and keep up with necessary maintenance. These factors made KLCO a good selection for a thorough case study on the hazards involved in Malaysian performing arts theatre. Figure 3.1 shows the overall methodology for this research. While Figure 3.2 shows the overall schedule of work.

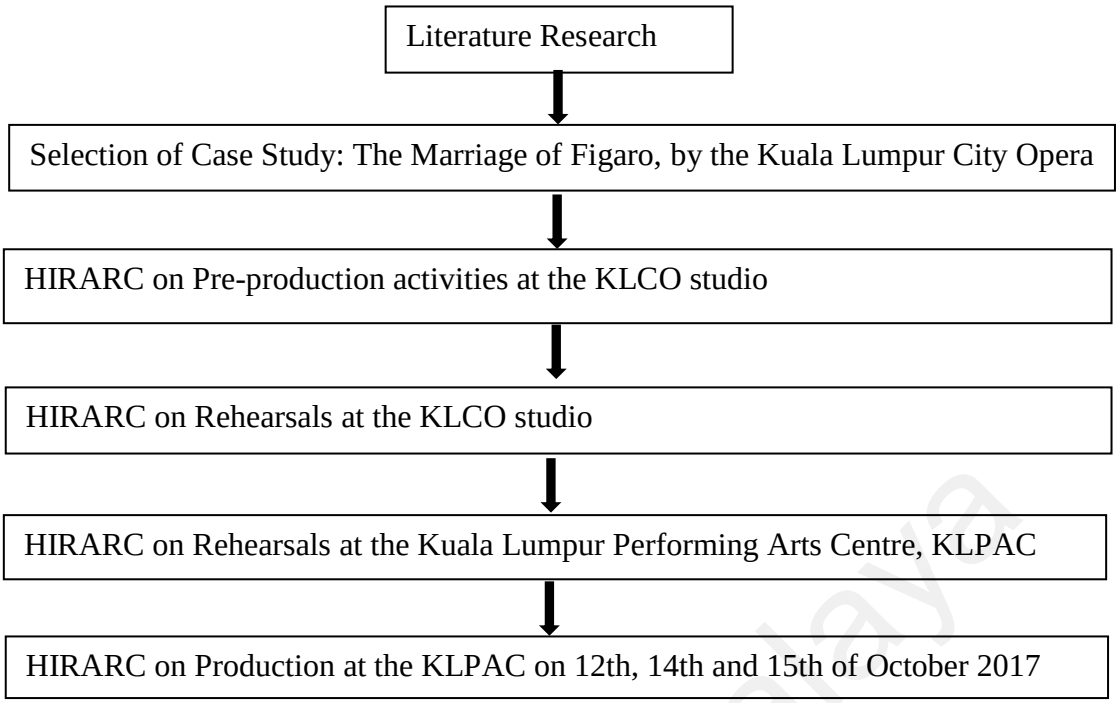

Figure 3.1 Overall Research Methodology

Activity & Task	Month										
	1	2	3	4	5	6	7	8	9	10	11
Literature Review											
Data Collection											
Initial Risk Ranking											
Risk recommendations											
Final Risk Ranking											
Data Analysis											
Result Discussion											
Report Writing											

Figure 3.2 Overall Schedule of Work

The first location of study was at the theatre company's operating studio, the KLCO Studio, followed by the actual performing arts theatre, KLPAC, where the production was performed for public viewing. Hazards were captured and analysed by conducting a Hazard Identification, Risk Assessment and Risk Control (HIRARC) exercise on the theatre company's production activities from the pre-production phase up to the production phase. The HIRARC methodology includes:

1) The KLCO theatre company was contacted to obtain agreement for collaboration on carrying out a HIRARC on one of its productions. The production details such as number of cast members, number of musicians, location of rehearsals, rehearsal schedule, theatre set up schedule and performance schedules were obtained. Current safety procedures observed by the company were communicated for reference.

2) The various locations involved in the production were identified and populated into HIRARC tables. The tables were broken down into production and pre-production departments followed by the job steps carried out by each section.

3) Visual inspection was carried out on the KLCO studio to identify inherent hazards at the venue. Each phase of the rehearsal process at the studio was observed and all possible hazards identified and noted in the appropriate section of the HIRARC table.

4) Visual inspection was carried out on the actual performing arts theatre, KLPAC, hall where the performance was held to identify inherent hazards at the venue. The load-in / load-in of theatrical properties, lighting and sound equipment set-up, technical rehearsal, dress rehearsals and actual performances to the public was observed and all possible hazards identified and noted in the appropriate section of the HIRARC table. The same was done during the bump-out / load-out of theatrical properties, lighting and sound equipment.

5) Current risk controls available was noted in the HIRARC table. Then, all risks were ranked by level of likelihood and severity according to the HIRARC risk matrix while taking into account the current risk controls. The risks were analysed using semi-qualitative analysis.

6) Appropriate recommendations were given for each risk to reduce the risk ranking for improved operations. Dedicated tools and templates were developed or modified to include identified Safety, Health and Environment risk control.

A semi-qualitative analysis was carried out on the hazards identified. Numbers were assigned to likelihood and severity of risk. The risk level was then calculated according to the following formula [19]:

$$\text{Risk Rank} = \text{Likelihood} \times \text{Severity}$$

Likelihood and severity values were assigned according to the following table that was developed based on general Guidelines for Hazard Identification, Risk Assessment and Risk Control (HIRARC) for use in various Malaysian industries [19]. The corresponding risk ranking values are shown in Table 3.1:

Table 3.1: Hazard Identification, Risk Assessment and Risk Control (HIRARC) risk matrix [19]

LIKELIHOOD		SEVERITY				
		1	**2**	**3**	**4**	**5**
		No injury or property damage	**Minor (First Aid) or Small damage**	**Moderate (> 4 days Medical Leave) or Moderate damage**	**Major (>4 days Medical Leave) or Major damage**	**Fatality or Business Interruption**
Frequent & Very Likely	5	5	10	15	20	25
Likely & Probable	4	4	8	12	16	20
Occasional	3	3	6	9	12	15
Unlikely	2	2	4	6	8	10
Very Unlikely	1	1	2	3	4	5

Risk control measures were recommended based on source control, engineering control, administrative control and personal protective equipment (PPE). In source control, specific risks sources were eliminated completely or substituted for a more favourable alternative. Engineering control employed the use of engineered equipment to reduce risk exposure or eliminate risk. Administrative control focused on

the processes, procedures, training and signage used to inculcate a safe working culture among production workers. The last and least favoured risk control was personal protective Equipment (PPE) that referred to devices that could protect the individual worker from harm, such as safety helmets, earplugs and anti-vibration gloves.

CHAPTER 4: RESULTS AND DISCUSSION

4.0 Results and Discussion

The results of this research are presented in the sections below.

4.1 Hazard Identification, Risk Assessment and Risk Control (HIRARC)

The HIRARC exercise results are shown in HIRARC tables. These tables cover the theatre company's production activities from the pre-production phase up to the production phase at the KLCO studio and KLPAC theatre. Each table is labelled with the type of activity / task, location, department and date of assessment. The HIRARC tables are divided into activities carried out at the KLCO studio, which is the rehearsal space, and the KLPAC theatre, which is the performing arts theatre where the shows are shown to the public. Each table is given a brief introduction in the following paragraphs with the aid of relevant pictures to enable clear visualisation of safety issues.

Table 4.1 presents the HIRARC of Marketing, Administration and Coordination Activities at the KLCO studio. The main activities identified are Administration and artistic Meetings, Selection of preferred production, Budget preparation, preparation of rehearsal schedule, audition of principal cast, audition of additional chorus members, appointment of Stage Director, appointment of Stage Manager, appointment of Assistant Stage Manager and production meetings. Refer to Table 4.1 for the hazards, risk level and mitigation measures identified for this department.

Table 4.2 presents the HIRARC of Production Activities at the KLCO studio. The main activities identified are the set-up of the mock stage using markers (Figure

4.1), properties and set preparation that includes sand papering and painting (Figures 4.3, 4.4 and 4.5), preparation of the properties (props) table (Figure 4.2), Production Schedule preparation, documentation of blocking, choreography of movement and dance, obtaining dedicated props for each scene and transfer of props and set to the theatre. The figures mentioned in this paragraph are shown below for better understanding of Table 4.2.

Figure 4.1: Property markers on the ground at Kuala Lumpur City Opera, KLCO studio

Figure 4.2: Properties table at Kuala Lumpur City Opera, KLCO studio

Figure 4.3: Properties at Kuala Lumpur City Opera, KLCO studio

Figure 4.4: Properties at Kuala Lumpur City Opera, KLCO studio

Figure 4.5: Properties at Kuala Lumpur City Opera, KLCO studio

Table 4.3 presents the HIRARC of Stage Set up and Management Activities at the KLCO studio. The main activity identified is set movement choreography and set movement between scenes. Although this area has only one main step, its activities include a lot of physical movement and lifting of properties and set items. Therefore, risks such as breakable items, tripping or collision are prevalent.

Table 4.4 presents the HIRARC of Performance (Cast) Activities at the KLCO studio. The main activities identified in this department are Principals' rehearsals, Chorus Rehearsals, Opera for Kids workshop that teaches child cast members about the opera performance and their roles on stage, combined rehearsal of Principals, Chorus and orchestra, combined rehearsal of Principals and Chorus, and blocking of scenes which fixes the position and choreography for each cast member on stage throughout the entire show. Each section of the rehearsal is carried out individually until about one month prior to the show. At this point, the various sections come together to combine their parts into a single performance.

Table 4.5 presents the HIRARC of Performance (Orchestra) Activities at the KLCO studio. The main activities identified are Orchestra rehearsal, transport of musical instruments into the studio and maintenance of musical instruments. These activities entail static and sustained work postures by the orchestra members and heavy lifting of possibly large musical instruments into the rehearsal studio. As the studio is located on the second floor without an elevator, lifting through the staircase could also pose tripping hazards.

Table 4.6 presents the HIRARC of Costume selection and Fitting Activities at the KLCO studio. The main activity identified in this department is costume fitting. Costume fitting is important as all cast members would use the costumes prepared by the costume designer while on stage and during dress rehearsals. Therefore, each costume must be tailored to the cast member so that he or she can move freely on stage without tripping or sustaining other forms of injury due to their costumes.

Table 4.7 presents the HIRARC of Load-in Activities at the KLPAC theatre. The main activities covered in this section are unloading props at the theatre through the loading bay, set up of stage platform, and stage set up using the theatrical rigging system (refer to Figures 4.6, 4.7, 4.8, 4.9, 4.10 and 4.11). Manual stage lighting adjustment is also carried out by the lighting designer from a portable Genie lift, so that he can reach the lights on the lighting beam which is close to the ceiling (refer to Figures 4.12, 4.13 and 4.14. Set building / modification Sawing, nailing, drilling and handling wood are also covered in Table 4.7.

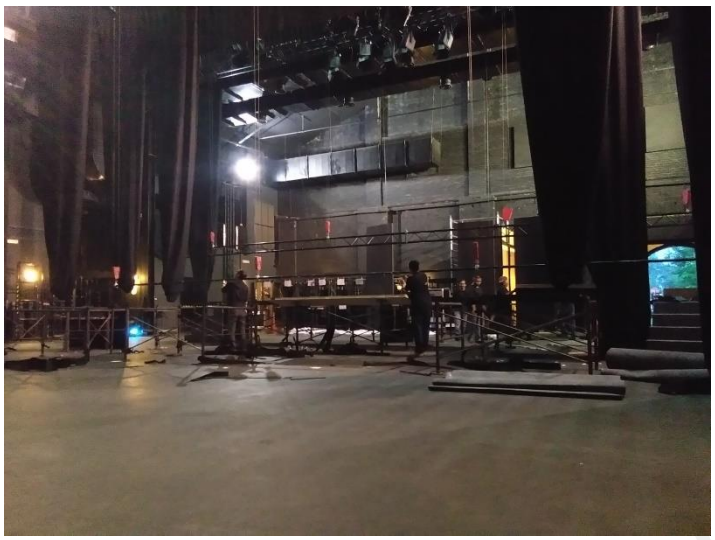

Figure 4.6: Set up of Stage Platform at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Figure 4.7: Stage set up at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

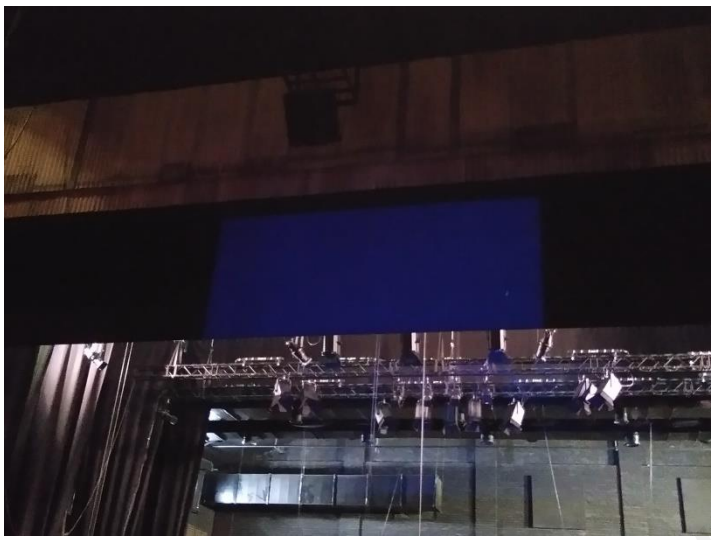

Figure 4.8: Stage set up at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Figure 4.9: Setting up of stage backdrop at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Figure 4.10: Dangling counterweights during stage set up at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Figure 4.11: Protruding beams during stage set up at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Figure 4.12: Setting up of stage lighting at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

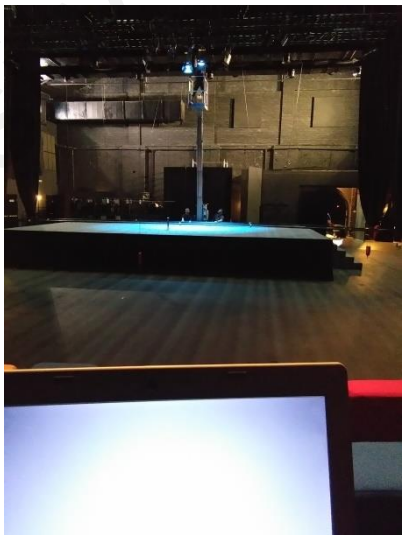

Figure 4.13: Genie lift being used to adjust stage lighting at Pentas 1, Kuala Lumpur Performing Arts Centre

Figure 4.14: Finished stage backdrop and lighting at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Table 4.8 presents the HIRARC of Front of House (FOH) Activities at the KLPAC theatre. The main activities carried out under this section are ushering of audience to their designated seat, ushering audience and VIP from Ground Floor to Pentas 1 located on the first floor, manning the ticketing counter and activities carried out by the Front of House Manager. The FOH team is made up of cast members from the KLCO chorus and other volunteers. Cast members would be dressed in their performance costumes while carrying out their tasks under the FOH before the show and during the show intermission. Volunteers are dressed in smart casual attire or formal attire. The FOH Manager is in charge of coordinating the overall FOH team activities and delegating tasks to the team.

Table 4.9 presents the HIRARC of Production Activities at the KLPAC theatre. The main activities covered are set up of stage using markers on the ground, transfer of props and set to the theatre, preparation of props table, documentation of final blocking, lighting ques, manual sound effects, preparing cast for pre-scene stand by as well as removal and disposal of broken props from stage. Refer to Figures 4.15, 4.16, 4.17, 4.18 and 4.19 below for properties table set up.

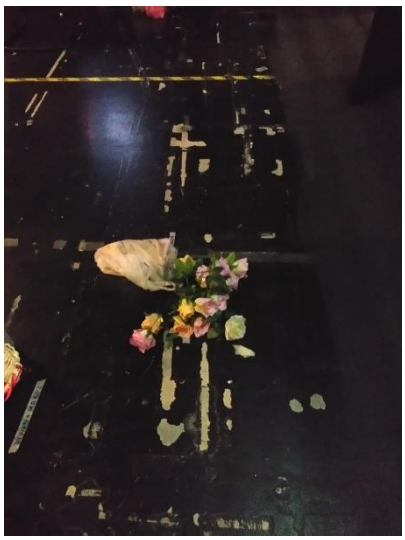

Figure 4.15: Properties left on the ground backstage at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Figure 4.16: Properties table backstage at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Figure 4.17: Properties backstage at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Figure 4.18: Properties backstage at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Figure 4.19: Safety markers indicating tripping hazard at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Table 4.10 presents the HIRARC of Performance (Technical team) Activities at the KLPAC theatre. The main activities covered under this section are those of the lighting and sound operators, implementing lighting and sound cues as well as operating surtitles. As the opera was in sung in Italian for a predominantly Malaysian audience, surtitles were projected above the stage and operated throughout the show to translate each line into English and Mandarin. Surtitles operators were on duty throughout each show to ensure that the surtitles moved in time with the lines delivered on stage. Figure 4.20 shows the technical control area.

Figure 4.20: Technical Control Area at Pentas 1, Kuala Lumpur Performing Arts Centre

Table 4.11 presents the HIRARC of Performance (Cast) Activities at the KLPAC theatre. The main activities covered under this section are the Full Dress Rehearsal, Performance, standing by back stage an onstage performance. In this section, cast members are dressed in full costume, and carry out all aspect of the actual performance to the extent of their involvement. Cast members that do not appear throughout the entire show would wait at the dressing room and standby backstage with their props before they are due on stage. As backstage would be in darkness or with very low lighting, visibility backstage would be significantly low. Refer to Figures 4.21, 4.22, 4.23, 4.24 and 4.25 for a clear picture of backstage, entrances onto the stage, walkways and various tripping hazards backstage.

Figure 4.21: Glow tape on the edges of Stage Properties at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

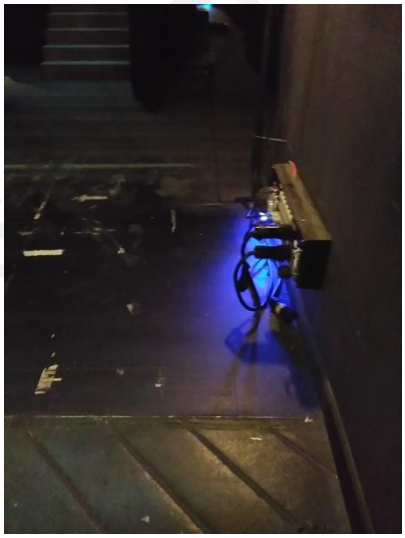

Figure 4.22: Backstage dim light for warning against tripping on wiring at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

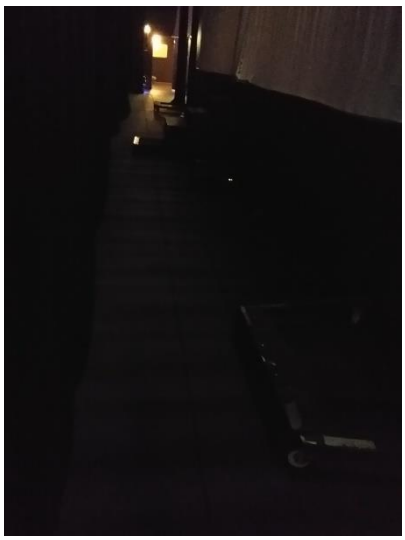

Figure 4.23: Walkway to the middle backstage staircase at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

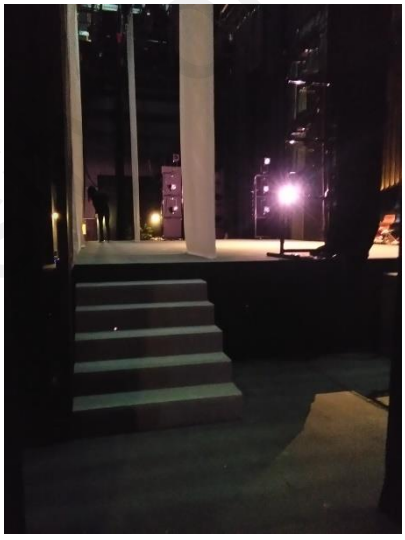

Figure 4.24: Right stage staircase at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Figure 4.25: Wiring on the ground backstage at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Table 4.12 presents the HIRARC of Performance (Orchestra) Activities at the KLPAC theatre. The main activities covered under this section are the orchestra rehearsal, transport of musical instruments into the theatre and the orchestra performance during shows. Possible heavy lifting of musical instruments and static, sustained work posture are among the hazards faced by this section. Throughout the show, the orchestra sits in the orchestra pit, located in front of the stage. The Conductor conducts the orchestra along with all cast members on stage while they make music with their instruments or voices. The music stands used by the orchestra during shows at the theatre are brought in from the rehearsal studio. Figures 4.26 and 4.27 show the orchestra's music stands that were packed for transferred from the rehearsal studio to the theatre.

Figure 4.26: Music stands at Kuala Lumpur City Opera, KLCO studio

Figure 4.27: Folded Music stand at Kuala Lumpur City Opera, KLCO studio

Table 4.13 presents the HIRARC of Performance (Audience) Activities at the KLPAC theatre. The main concerns for the audience include finding their designated seat, leaving theatre while the show is going on and knowing the escape route from the theatre in case of emergencies. The audience is guided by the FOH team to their designated seats before the start of the show. During this time, lighting at the theatre

would be slightly low. However, when the show has begun, the lights are turned off. Audience entering or leaving the theatre while the show is going on may result in tripping or faling as visibility is low. Figures 4.28, 4.29, 4.30, 4.31, 4.32 and 4.33 show the interior of the performance venue, which is Pentas 1, KLPAC, including seats, stairways, tripping hazards and exits.

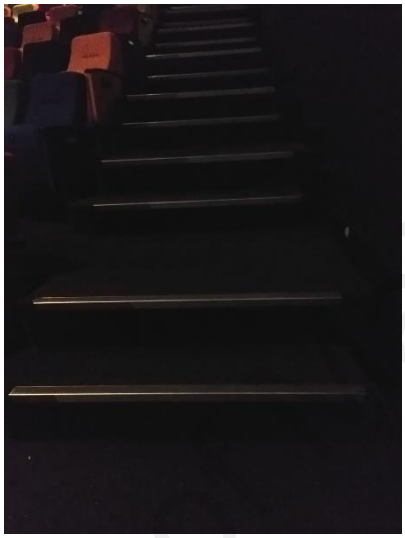

Figure 4.28: Audience staircase at Pentas 1, Kuala Lumpur Performing Arts Centre

Figure 4.29: Tripping hazard at Pentas 1, Kuala Lumpur Performing Arts Centre

Figure 4.30: Audience seats at Pentas 1, Kuala Lumpur Performing Arts Centre

Figure 4.31: Audience Staircase at Pentas 1, Kuala Lumpur Performing Arts Centre

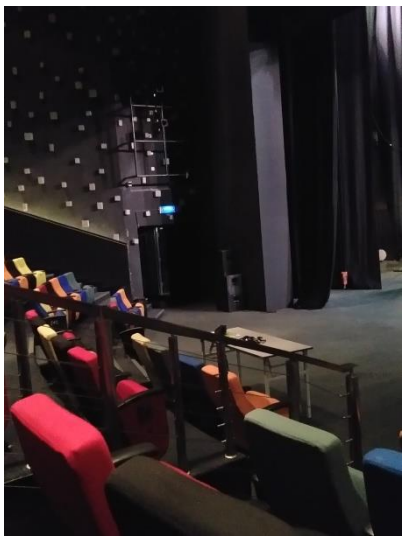

Figure 4.32: Exit from Audience Left at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Figure 4.33: Exit from Audience Right at Pentas 1, Kuala Lumpur Performing Arts Centre, KLPAC

Table 4.14 and 4.15 present the HIRARC of Hair and Make-up Activities as well as the HIRARC of Costume Preparation and Adjustment Activities at the KLPAC theatre. The main activities under Hair and Make-up affect the Hair and Make-up artists as they would face a long duration of exposure to Hair and Make-up chemicals. Cast members would only face exposure during their own make over session. The

main activities under Costume Preparation and Adjustment are onsite costume alterations, guiding cast members on correct usage of costumes and costume fitting. Major measurements and alteration to the costume are done before load-in to the theatre. However, last minute adjustments are still required if the cast member has lost or put on weight, or face other issues with the costume. Onsite alterations are important to ensure that cast members are comfortable and that their movement onstage and offstage are not impaired due to their costumes.

4.1.1 Hazard Identification, Risk Assessment and Risk Control (HIRARC) of Activities at the Rehearsal Space

Tables 4.1, 4.2, 4.3, 4.4, 4.5 and 4.6 show the HIRARC results of activities carried out at the rehearsal space for the production of The Marriage of Figaro by KLCO. The rehearsal space in question is the KLCO studio. Work processes were categorised into Marketing, Administration and Coordination Activities, Production Activities, Stage Set up and Management Activities, Performance (Cast) Activities, Performance (Orchestra) Activities, and Costume selection and Fitting Activities.

Table 4.1: HIRARC of Marketing, Administration and Coordination Activities at the Rehearsal Space

TYPES OF ACTIVITY / TASK		Marketing, administration and coordination							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT			Marketing	SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
1	Administration and artistic Meetings	1) Working more than 8 hours per day	1) Fatigue	1) Rest day on Sundays	5	1	5		1) Develop responsibility matrix for each task	Stage Manager and KLCO Administration
			2) Stress		5	1	5		2) Meetings to be conducted not exceeding 10pm	Meeting chairman
							0		3) Facilities for medical claim for illness incurred during production period	KLCO Administration
							0		4) Allocation of adequate rest days	Production Team and KLCO Administration
		2) Prolonged stationery position	1) Body injury (chronic)	None	4	3	12		1) Hourly breaks	Meeting chairman

TYPES OF ACTIVITY / TASK		Marketing, administration and coordination							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT			Marketing	SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
2	Selection of preferred production						0			
3	Budget preparation						0			
4	Preparation of rehearsal schedule						0			
5	Audition of principal cast						0			
6	Audition of additional chorus members						0			
7	Appointment of Stage Director						0			
8	Appointment of Stage Manager						0			
9	Appointment of Assistant Stage Manager						0			

TYPES OF ACTIVITY / TASK		Marketing, administration and coordination							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT			Marketing	SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
10	Production meetings	1) Working more than 8 hours per day	1) Fatigue	Rest day on Sundays	5	1	5		1) Develop responsibility matrix for each task	Stage Manager and KLCO Administration
			2) Stress		5	1	5		2) Meetings to be conducted not exceeding 10pm	Meeting chairman
							0		3) Facilities for medical claim for illness incurred during production period	KLCO Administration
							0		4) Allocation of adequate rest days	Production Team and KLCO Administration
		2) Prolonged stationery position	1) Body ache	None	4	3	12		1) Hourly breaks	Meeting chairman
11	Media releases						0			

TYPES OF ACTIVITY / TASK		Marketing, administration and coordination							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT			Marketing	SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
12	Sourcing promotion partners						0			
13	Sourcing sponsors						0			
14	Interview with the media						0			

Table 4.2: HIRARC of Production Activities at the Rehearsal Space

TYPES OF ACTIVITY / TASK		Production							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
1	Set up of mock stage (markers)	1) Awkward work posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	2	10		1) Visible pictorial signage on ergonomic posture related do's and don'ts.	KLCO Administration
			2) Body injury (chronic)	none	5	3	15		2) Safety briefing for stage hands and Production Team.	KLCO Administration
2	Properties and set preparation (sand papering, painting)	1) Abrasive surface	1) Abrasion injury	none	4	2	8		1) Require usage of glove while using sandpaper	KLCO Administration
3	Preparation of props table						0			
4	Production Schedule preparation						0			

TYPES OF ACTIVITY / TASK		Production							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
5	Documentation of blocking						0			
6	Choreography of movement and dance	1) Awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	2	10		1) Mandatory warm up exercises before dance or stage rehearsal	Choreographer, Production Team
			2) Body injury (chronic)	none	5	3	15		2) Visible pictorial signage on proper warm up exercises before dance or stage rehearsal	KLCO Administration
7	Obtaining dedicated props for each scene	1) Sharp edges	1) Hand injury	none	4	2	8		1) Using PPE	KLCO Administration
		2) Frequent bending and twisting, incorrect lifting, incorrect carrying.	2) Body injury (acute)	none	5	2	10		1) Visible pictorial signage on ergonomic posture related do's and don'ts.	KLCO Administration

TYPES OF ACTIVITY / TASK		Production							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
			3) Body injury (chronic)	none	5	3	15		2) Safety briefing for stage hands and Production Team.	KLCO Administration
		3)Tripping at staircase	4) Body injury (acute)	none	4	3	12		1) Facilities for medical claim for injuries incurred during transfer of items from studio to transport vehicle	KLCO Administration
							0		2) Visible pictorial signage to exercise caution while lifting items via staircase	KLCO Administration
		4) Sharp edges	5) Hand injury	none	4	2	8		1) Using PPE	KLCO Administration

TYPES OF ACTIVITY / TASK		Production							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
8	Transfer of props and set to theatre	1) Frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	2	10		1) Visible pictorial signage on ergonomic posture related do's and don'ts.	KLCO Administration
			2) Body injury (chronic)	none	5	3	15		2) Safety briefing for stage hands and Production Team.	KLCO Administration
		2) Tripping at staircase	1) Body injury (acute)	none	4	3	12		1) Facilities for medical claim for injuries incurred during transfer of items from studio to transport vehicle	KLCO Administration
							0		2) Visible pictorial signage to exercise caution while lifting items via staircase	KLCO Administration

Table 4.3: HIRARC of Stage Set up and Management Activities at the Rehearsal Space

TYPES OF ACTIVITY / TASK		Stage set up and management							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
1	Set movement choreography and set movement between scenes.	1) Awkward work posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	3	15		Visible pictorial signage on ergonomic posture related do's and don'ts.	KLCO Administration
			2) Body injury (chronic)				0		Safety briefing for stage hands and Production Team.	KLCO Administration
		2) Mishandling of breakable items	1) Body injury (acute)	none	4	2	8		Safety briefing for stage hands and Production Team.	KLCO Administration
							0		Immediate clearing of broken items from mock stage area	Production Team

TYPES OF ACTIVITY / TASK		Stage set up and management							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		3) Tripping or collision	1) Body injury (acute)	none	3	2	6		Safety briefing for stage hands and Production Team.	KLCO Administration
			2) Body injury (chronic)	none	3	3	9		Safety briefing for stage hands and Production Team.	KLCO Administration
							0		Set movement choreography to be done with safety of set movers and cast members as top priority (artistic intent and aesthetics are secondary to safety).	Production Team
							0		Employ trained movers / train stage hands for complex set movement	Production Team

Table 4.4: HIRARC of Performance (Cast) Activities at the Rehearsal Space

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
1	Principals rehearsal	1) Vocal strain	1) Damage to vocal folds	Vocal warm up exercises	3	3	9		1) Ensure vocal warm up before singing rehearsal	Vocal Director, Chorus Master, Opera for Kids facilitator
							0		2) Plan rehearsals and if there is insufficient time for group vocal warm up, instruct and remind singers to do proper vocal warm up prior to rehearsals.	Vocal Director, Chorus Master, Opera for Kids facilitator

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		2) Awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	2	10		1) Mandatory warm up exercises before dance or stage rehearsal	Choreographer, Production Team
			2) Body injury (chronic)	none	3	3	9		2) Visible pictorial signage on proper warm up exercises before dance or stage rehearsal	KLCO Administration
		3) Tripping or collision	1) Body injury (acute)	none	4	2	8		1) Safety briefing for stage hands and cast members	Production team / KLCO Administration
			2) Body injury (chronic)	none	4	3	12		2) Safety briefing for stage hands and cast members	Production team / KLCO Administration

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
2	Chorus Rehearsal	1) Vocal strain	1) Damage to vocal folds	Vocal warm up exercises	3	3	9		1) ensure vocal warm up before singing rehearsal	Vocal Director, Chorus Master, Opera for Kids facilitator
							0		2) Plan rehearsals and if there is insufficient time for group vocal warm up, instruct and remind singers to do proper vocal warm up prior to rehearsals.	Vocal Director, Chorus Master, Opera for Kids facilitator
		2) Awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	2	10		1) Mandatory warm up exercises before dance or stage rehearsal	Choreographer, Production Team

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
			2) Body injury (chronic)	none	5	3	15		2) Visible pictorial signage on proper warm up exercises before dance or stage rehearsal	KLCO Administration
		3) Tripping or collision	1) Body injury (acute)	none	4	2	8		1) Safety briefing for stage hands and cast members	Production team / KLCO Administration
			2) Body injury (chronic)	none	4	3	12		1) Safety briefing for stage hands and cast members	Production team / KLCO Administration
3	Opera for Kids workshop	1) Vocal strain	1) Damage to vocal folds	Vocal warm up exercises	3	3	9		1) Ensure vocal warm up before singing rehearsal	Opera for Kids facilitator

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
							0		2) Plan rehearsals and if there is insufficient time for group vocal warm up, instruct and remind singers to do proper vocal warm up prior to rehearsals.	Vocal Director, Chorus Master, Opera for Kids facilitator
		2) Awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	2	10		1) Mandatory warm up exercises before dance or stage rehearsal	Choreographer, Production Team
			2) Body injury (chronic)	none	5	3	15		2) Visible pictorial signage on proper warm up exercises before dance or stage rehearsal	KLCO Administration

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		3) Tripping or collision hazards for minors	1) Body injury	1) Do's and don'ts briefed and rigorously enforced by facilitators on participants	4	3	12		1) Warm up and cool down exercises	Head Facilitator
							0		2) Visible signage on do's and don'ts to remind participants to abide by rules at all times	KLCO Administration
							0		3) Safety briefing for Opera for Kids participants	Production team / KLCO Administration / Opera for Kids facilitators

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		4) Unauthorised visitors	1) Body injury	1) Visitors monitored by Studio Executive Producers or Administration team representative	2	4	8		1) Emergency contact numbers made visible near studio telephone and on notice boards.	Studio Executive Producers / Administration
			2) Kidnapping		2	5	10		2) Install CCTV and intercom to monitor doorway of studio and selectively allow entrance by authorised persons	KLCO Administration
4	Combined rehearsal of Principals, Chorus and orchestra	1) Static and sustained work posture	1) Body injury (chronic)	None	5	3	15		1) Enforce mandatory breaks for orchestra members every 1 hour	Conductor / Concert Master

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		2) Awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying by orchestra	2) Body injury (acute)	none	5	2	10		2) Mandatory sectional warm up exercises for orchestra before rehearsal	Conductor / Concert Master / Section leader
							0		3) Visible signage to warm up before rehearsal	KLCO Administration
		3) Vocal strain	1) Damage to vocal folds	1) Vocal warm up exercises	3	3	9		1) Ensure vocal warm up before singing rehearsal	Vocal Director, Chorus Master, Opera for Kids facilitator

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
							0		2) Plan rehearsals and if there is insufficient time for group vocal warm up, instruct and remind singers to do proper vocal warm up prior to rehearsals.	Vocal Director, Chorus Master, Opera for Kids facilitator
		4) Static and sustained work posture by singers, particularly chorus members who sit in confined space while waiting for long periods.	1) Body injury (chronic)	none	5	3	15		1) Visible pictorial signage to remind singers to take a break from sitting or do stretching exercises outside the rehearsal space while waiting for their next appearance.	KLCO Administration

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
5	Combined rehearsal of Principals and Chorus	1) Vocal strain	1) Damage to vocal folds	1) Vocal warm up exercises	3	3	9		1) Ensure vocal warm up before singing rehearsal	Vocal Director, Chorus Master, Opera for Kids facilitator
							0		2) Plan rehearsals and if there is insufficient time for group vocal warm up, instruct and remind singers to do proper vocal warm up prior to rehearsals.	Vocal Director, Chorus Master, Opera for Kids facilitator
		2) Awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	2	10		1) Mandatory warm up exercises before dance or stage rehearsal	Choreographer, Production Team

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
			2) Body injury (chronic)	none	5	3	15		2) Visible pictorial signage on proper warm up exercises before dance or stage rehearsal	KLCO Administration
		3) Tripping or collision	1) Body injury (acute)	none	4	2	8		1) Safety briefing for stage hands and cast members	Production team / KLCO Administration
			2) Body injury (chronic)	none	4	3	12		2) Safety briefing for stage hands and cast members	Production team / KLCO Administration
6	Blocking of scenes						0			

Table 4.5: HIRARC of Performance (Orchestra) Activities at the Rehearsal Space

TYPES OF ACTIVITY / TASK		**Performance – orchestra**							**DATE: 16/10/2017**	
LOCATION		**Kuala Lumpur City Opera Studio**			**DEPARTMENT**				**SECTION / OFFICE:**	
No.	**JOB / PROCESS SEQUENCE**	**HAZARD IDENTIFICATION**		**CURRENT RISK CONTROL**	**CURRENT RISK RATING**			**LAW REQUIREMENTS**	**ADDITIONAL RISK CONTROL**	
		Hazard	**Effects**		**Likelihood**	**Severity**	**Risk Rank**		**ACTIONS RECOMMENDED**	**ACTION BY**
1	Orchestra rehearsal	1) Static and sustained work posture	1) Body injury (chronic)	None	5	3	15		1) Enforce mandatory breaks for orchestra members every 1 hour	Conductor / Concert Master
		2) Awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	2) Body injury (acute)	none	4	2	8		2) Mandatory sectional warm up exercises for orchestra before rehearsal	Conductor / Concert Master / Section leader
							0		3) Visible signage to warm up before orchestra rehearsal	KLCO Administration

TYPES OF ACTIVITY / TASK		Performance – orchestra							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		3) Noise	1) Noise Induced Hearing Loss	none	4	2	8		1) Supply orchestra members with noise dosimeters and train them how to read noise exposure at the end of their working day.	Orchestra members
									2) Provide training to orchestra members on Noise Induced Hearing Loss	Safety Committee

TYPES OF ACTIVITY / TASK		Performance – orchestra							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
									3) Train orchestra members on the Permissible Exposure Limits for continuous (=< 90dB). Action Level (85 dB) and impulsive (=<140 dB) noise exposure so that they can make informed decisions about the quantity of hours they spend being exposed to noise via performances and rehearsals.	Safety Committee
2	Transport of musical instruments into studio	1) Sharp edges	1) Hand injury	none	3	2	6		1) Safety briefing for orchestra	KLCO Administration

TYPES OF ACTIVITY / TASK		Performance – orchestra							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		2) Frequent bending and twisting, incorrect lifting, incorrect carrying.	2) Body injury (acute)	none	4	2	8		2) Visible pictorial signage on ergonomic posture related do's and don'ts.	KLCO Administration
			3) Body injury (chronic)	none	4	3	12		3) Safety briefing for stage hands and Production Team.	KLCO Administration
		3) Tripping at staircase	1) Body injury (acute)	none	3	2	6		1) Facilities for medical claim for injuries incurred during transfer of items from studio to transport vehicle	KLCO Administration
							0		2) Visible pictorial signage to exercise caution while lifting items via staircase	KLCO Administration

TYPES OF ACTIVITY / TASK		Performance – orchestra							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
3	Maintenance of musical instruments						0			

Table 4.6: HIRARC of Costume selection and Fitting Activities at the Rehearsal Space

TYPES OF ACTIVITY / TASK		**Costume selection and fitting**							**DATE: 16/10/2017**	
LOCATION		**Kuala Lumpur City Opera Studio**			**DEPARTMENT**				**SECTION / OFFICE:**	
No.	**JOB / PROCESS SEQUENCE**	**HAZARD IDENTIFICATION**		**CURRENT RISK CONTROL**	**CURRENT RISK RATING**			**LAW REQUIREMENTS**	**ADDITIONAL RISK CONTROL**	
		Hazard	**Effects**		**Likelihood**	**Severity**	**Risk Rank**		**ACTIONS RECOMMENDED**	**ACTION BY**
1	Costume selection based on production						0			
2	Measuring cast members' clothing size						0			
3	Alteration of costumes to fit cast members						0			
4	Onsite costume alterations						0			
5	Guiding cast members on correct usage of costumes						0			

TYPES OF ACTIVITY / TASK		Costume selection and fitting							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
6	Transport of costumes to rehearsal studio for fitting						0			
7	Transport of costumes for alteration						0			
8	Costume fitting	1) Tripping in costume	1) Body injury (acute)	1) Ensure skirt line is not sweeping the floor when worn.	4	2	8		1) Height measurement to include adequate margin to prevent tripping	Costume designer
				2) Instruction to singers to wear secure footwear			0		2) Issue pictorial guidelines to cast members on required secure theatre footwear	KLCO Administration

TYPES OF ACTIVITY / TASK		Costume selection and fitting							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
				3) Rehearsal for principal female cast with actual stage footwear and similar actual long skirt.			0		3) Prepare list of stunts and map each stunt with desired costume. Alter costume or alter stunt as necessary to ensure safety of cast members.	KLCO Administration
		2) Sharp edges	1) Body injury (acute)	1) Ensure all safety pins and other cloth pins are removed from costume or that their sharp edges are securely hooked in place.			0		1) Fitting Inspection by costume designer before first rehearsal or after any costume alteration is made.	Costume Designer

TYPES OF ACTIVITY / TASK		Costume selection and fitting							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
							0		2) Immediate feedback from cast members to costume designer for unpadded sharp edges in costume.	Cast members
		3) Tight costumes	1) Breathing difficulties	1) Ensure corsets and belts are not too tight for cast members	3	1	3		1) Fitting Inspection by costume designer before first rehearsal or after any costume alteration is made.	Costume Designer
							0		2) Immediate feedback from cast members to costume designer to adjust size of costume	Cast members

TYPES OF ACTIVITY / TASK		Costume selection and fitting							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
			2) Body injury (acute)	1) Ensure corsets and belts are not too tight for cast members	3	2	6		1) Fitting Inspection by costume designer before first rehearsal or after any costume alteration is made.	Costume Designer
							0		2) Immediate feedback from cast members to costume designer to adjust size of costume	Cast members
		4) Tripping hazard due to insecure stage shoes	1) Body injury (acute)	1) Verbal reminder by costume designer to have covered shoes in black colour.	4	2	8		1) Issue pictorial guidelines to cast members on secure theatre footwear (no defects in soles, with functioning buckle if necessary)	KLCO Administration

TYPES OF ACTIVITY / TASK		Costume selection and fitting							DATE: 16/10/2017	
LOCATION		Kuala Lumpur City Opera Studio			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
							0		2) Inspection by costume designer on cast members' footwear before first rehearsal or after any change in footwear is made.	Costume Designer

4.1.2 Hazard Identification, Risk Assessment and Risk Control (HIRARC) of Activities at the Performance Venue

Tables 4.7, 4.8, 4.9, 4.10, 4.11, 4.12, 4.13, 4.14 and 4.15 show the HIRARC results of activities carried out at the performance venue for the production of The Marriage of Figaro by KLCO. The performance venue in question is the KLPAC. Work processes were categorised into Load-in Activities, Front of House Activities, Production Activities, Performance (Technical team) Activities, Performance (Cast) Activities, Performance (Orchestra) Activities, Performance (Audience) Activities, Hair and Make-up Activities, and Costume Preparation and Adjustment Activities.

Table 4.7: HIRARC of Load-in Activities at the Performance Venue

TYPES OF ACTIVITY / TASK		Load-in							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
1	Unloading props at theatre through loading bay	1) Lifting	1) Body injury		5	2	10		Ensure adequate personnel protection equipment is worn.	KLCO Administration / KLPAC
		2) Sharp edges	1) Body injury		5	2	10		Ensure adequate personnel protection equipment is worn.	KLCO Administration / KLPAC
2	Set up of stage platform	1) Awkward work posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)		5	2	10		1) Apply ergonomic posture related do's and don'ts.	KLCO Administration / KLPAC

			2) Body injury (chronic)		5	3	15		1) Apply ergonomic posture related do's and don'ts.	KLCO Administration / KLPAC
		2) Sharp edges	1) Body injury (acute)		5	2	10		Ensure adequate personnel protection equipment is worn.	KLCO Administration / KLPAC
3	Set building / modification						0			
4	Sawing, nail gun, drilling, handling wood	1) Working with sharp edged tools	1) Body injury	none	5	4	20		1) PPE (gloves, covered shoes, long pants, no sandals, no short pants)	KLPAC management, Production Team (liaising with Contractors)
		2) Untrained personnel on site (cast members are not trained to handle sharp edged tools)	1) Body injury	none	3	4	12		1) Portable signage, indicating high risk workstation	KLPAC management, Production Team
							0		2) Safety briefing for Cast members on load-in hazards prior to load-in at theatre	Production Team

5	Stage set up (using theatrical rigging system)	1) Dangling counterweights	1) collision, body injury	1) bright colouring of weights	4	3	12		1) Portable signage, indicating high risk workstation	KLPAC management, Production Team
							0		2) Safety briefing for Cast members on load-in hazards prior to load-in at theatre	Production Team
			2) tripping, body injury	1) bright colouring of weights	4	3	12		1) Portable signage, indicating high risk workstation	KLPAC management, Production Team
							0		2) Safety briefing for Cast members on load-in hazards prior to load-in at theatre	Production Team
		2) Protruding beams resting on stage	1) collision, body injury	none	4	3	12		1) Portable signage, indicating high risk workstation	KLPAC management, Production Team
							0		2) Safety briefing for Cast members on load-in hazards prior to load-in at theatre	Production Team
			2) tripping, body injury		4	3	12		1) Portable signage, indicating high risk workstation	KLPAC management, Production Team

							0		2) Safety briefing for Cast members on load-in hazards prior to load-in at theatre	Production Team
		3) Required cable for hoisting described verbally to operator based on relative location. Operator unclear on which cable to adjust.	1) Immediate emergency hoisting or lowering not possible, body injury	none	5	4	20		1) Cables should be labelled and mapped to hoisting switch to enable clear instructions to operator.	KLPAC management
							0		2) Operators should be thoroughly trained in giving and receiving cable adjustment instructions	KLPAC management
		4) Cables hitting gridlines	1) Worn out / burst cables, body injury	1) manual alert to operator based on observation by ground crew and operator intervention	5	4	20		1) Proper cable maintenance	KLPAC management

							0		2) Install indicator to alert operator of cable contact with gridline	KLPAC management
			2) Falling objects, beams, counterweights		5	4	20		3) PPE (safety helmet) used by all workers while cable hoisting activities are in progress.	KLPAC management
		5) Cables stuck or tangled	1) Immediate emergency hoisting or lowering not possible, body injury		5	4	20		1) Proper cable maintenance	KLPAC management
							0		2) PPE (safety helmet) used by all workers while cable hoisting activities are in progress.	KLPAC management
6	Manual stage lighting adjustment on Lighting beam from high place	1) Falling from elevated mobile lift	1) Body injury	none	4	4	16		1) Safety harness for person on Genie lift	KLPAC management
		2) Moving of elevated mobile lift while occupied	1) Body injury	none	5	4	20		1) Safety harness for person on Genie lift	KLPAC management

							0		2) Lower elevation of lift before moving	KLPAC management
							0		3) PPE (safety helmet) used by workers moving Genie lift	KLPAC management

Table 4.8: HIRARC of Front of House Activities at the Performance Venue

TYPES OF ACTIVITY / TASK		**Front of House**							**DATE: 16/10/2017**	
LOCATION		**Kuala Lumpur Performing Arts Centre, KLPAC**			**DEPARTMENT**				**SECTION / OFFICE:**	
No.	**JOB / PROCESS SEQUENCE**	**HAZARD IDENTIFICATION**		**CURRENT RISK CONTROL**	**CURRENT RISK RATING**			**LAW REQUIREMENTS**	**ADDITIONAL RISK CONTROL**	
		Hazard	**Effects**		**Likelihood**	**Severity**	**Risk Rank**		**ACTIONS RECOMMENDED**	**ACTION BY**
1	Briefing						0			
2	Ushering audience to designated seat	1) Dim lights	1) Tripping, body injury	none	4	2	8		1) Visible markers on staircase in dim light	KLPAC management
							0		2) Use flashlight	KLCO Administration

TYPES OF ACTIVITY / TASK		Front of House							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
			2) Falling, body injury	none	4	4	16		1) Visible markers on staircase in dim light	KLPAC management
							0		2) Use flashlight	KLCO Administration
		2) Edge of staircase not marked with visible markers	1) Tripping, body injury	none	4	2	8		1) Visible markers on staircase in dim light	KLPAC management
							0		2) Use flashlight	KLCO Administration
			2) Falling, body injury	none	4	4	16		1) Visible markers on staircase in dim light	KLPAC management
							0		2) Use flashlight	KLCO Administration

TYPES OF ACTIVITY / TASK		Front of House							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
3	Ushering audience and VIP from Ground Floor to Pentas 1	1) Frequent ascending and descending of staircase	1) Tripping, body injury	1) Short working duration (maximum duration is 1.75 hours for VIP ushers combined with ground floor duty)	4	2	8		Ensure that FOH team is briefed on their work hours and reminded to be well rested prior to the shows.	KLCO Administration
			2) Falling, body injury	1) Short working duration (maximum duration is 1.75 hours for VIP ushers combined with ground floor duty)	4	4	16		Ensure that FOH team is briefed on their work hours and reminded to be well rested prior to the shows.	KLCO Administration

TYPES OF ACTIVITY / TASK		Front of House							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
4	Ticketing counter	1) Static and sustained work posture	1) Body injury (chronic)	1) Short working duration (maximum duration is 45 minutes, from stand-by until doors closed)	3	3	9		Ensure that FOH team is briefed on their work hours and reminded to be well rested prior to the shows.	KLCO Administration
5	Front of House Manager	1) Dim lights in Pentas 1	2) Tripping, body injury	none	4	2	8		1) Visible markers on staircase in dim light	KLPAC management
							0		2) Use flashlight	KLCO Administration
			3) Falling, body injury	none	4	4	16		1) Visible markers on staircase in dim light	KLPAC management
							0		2) Use flashlight	KLCO Administration

TYPES OF ACTIVITY / TASK		Front of House							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		2) Edge of Pentas 1 staircase not marked with visible markers	1) Tripping, body injury	none	4	2	8		1) Visible markers on staircase in dim light	KLPAC management
							0		2) Use flashlight	KLCO Administration
			2) Falling, body injury	none	4	4	16		1) Visible markers on staircase in dim light	KLPAC management
							0		2) Use flashlight	KLCO Administration
		3) Frequent ascending and descending of staircase from Ground Floor to Pentas 1	1) Tripping, body injury	none	4	2	8		1) Delegate task to Front of House crew during peak hours (before concert and during intermission)	Front of House Manager

TYPES OF ACTIVITY / TASK		Front of House							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
			2) Falling, body injury	none	4	4	16		1) Delegate task to Front of House crew during peak hours (before concert and during intermission)	Front of House Manager

Table 4.9: HIRARC of Production Activities at the Performance Venue

TYPES OF ACTIVITY / TASK		Production							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
1	Set up of stage (markers)	1) Awkward work posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	2	10		1) Visible pictorial signage on ergonomic posture related do's and don'ts.	Stage Manager
			2) Body injury (chronic)	none	5	3	15		2) Safety briefing for stage hands and Production Team.	Stage Manager
2	Transfer of props and set to theatre	1) Frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	2	10		1) Apply ergonomic posture related do's and don'ts.	Production Team

TYPES OF ACTIVITY / TASK		Production							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
			2) Body injury (chronic)	none	5	3	15		2) Safety briefing for stage hands and Production Team.	Stage Manager
3	Preparation of props table	1) Props blocking walkway during set up	1) Tripping, body injury	none	5	2	10		1) Ensure all props are placed against wall while setting up props table	Stage Manager
		2) Long, cylindrical props placed protruding out from beneath props table in dark back stage	1) Tripping, body injury	none	5	2	10		2) Ensure all long cylindrical props are placed in dedicated holder next to props table	Stage Manager

TYPES OF ACTIVITY / TASK		Production							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
4	Documentation of final blocking	1) Stunts through hazardous stage entry / exit, unforeseen during stage design	1) Body injury (acute)	none	5	3	15		1) Develop final installed stage stunt safety audit checklist	KLCO Safety committee / Production Safety representative
							0		2) Conduct stage stunt safety audit immediately after entire stage set up is done.	KLCO Safety committee / Production Safety representative
							0		3) Appoint Production Safety Representative	KLCO Safety committee / Production Safety representative
5	Lighting ques						0			
6	Manual sound effects						0			

TYPES OF ACTIVITY / TASK		Production							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
7	Preparing cast for pre-scene stand by (alert to cast at dressing room, ensuring props are ready at correct stage side)	1) Awkward work posture, frequent bending and twisting	1) Body injury (acute)	none	5	2	10		1) Appoint 1 dedicated Assistant Stage Manager for Stage Left, and 1 dedicated Stage Manager for Stage Right	Stage Manager
			2) Body injury (chronic)	none	5	3	15		2) Appoint 1 dedicated Assistant Stage Manager for Stage Left, and 1 dedicated Stage Manager for Stage Right	Stage Manager
8	Removal and disposal of broken props from stage	1) Sharp edges	1) Body injury (acute)	none	4	2	8		1) Safety briefing for stage hands and Production Team.	Stage Manager

TYPES OF ACTIVITY / TASK		Production							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
									2) Usage of PPE while handling sharp edges	
							0			

Table 4.10: HIRARC of Performance (Technical team) Activities at the Performance Venue

TYPES OF ACTIVITY / TASK		Performance (Technical team)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
1	Lighting and sound operators						0			
2	Lighting and sound cues						0			
3	Surtitles operator	1) Static and sustained work posture	1) Body injury (chronic)	1) Intermission breaks (20 minutes)	5	3	15		None	
				2) 2 operators for shift work			0		None	

Table 4.11: HIRARC of Performance (Cast) Activities at the Performance Venue

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
1	Full Dress Rehearsal / Performance						0			

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
2	Standby back stage	1) Low visibility	1) Body injury (acute)	1) Stage and Backstage safety tour / briefing by Stage Manager (advise caution backstage due to low visibility, enforce restricted areas for supporting cast to control hazards at backstage centre staircase)	5	2	10		1) Safety briefing to include warning of low visibility back stage	Stage Manager

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC		DEPARTMENT				SECTION / OFFICE:		
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
				2) Dedicated personnel appointed to escort children from holding room to back stage close to stage appearance time			0			
		2) Long, cylindrical props placed protruding out from beneath props table in dark back stage	1) Tripping, body injury	none	5	2	10		2) Ensure all long cylindrical props are placed in dedicated holder next to props table	Stage Manager

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
3	Onstage performance	1) Stunts through hazardous stage entry / exit, unforeseen during stage design	1) Body injury (acute)	none	5	3	15		1) Ensure sufficient flat landing clearance for scenes where cast jumps from onstage to offstage (e.g.: Cherubino jumps out of "window", drunken Antonio is shoved out the "door")	Director / Stage Designer / KLCO Safety committee / Production Safety representative
							0		2) Conduct Safety Review of Stage plans	Director / KLCO Safety committee / Production Safety representative

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
							0		3) Develop final installed stage stunt safety audit checklist	KLCO Safety committee / Production Safety representative
							0		4) Conduct stage stunt safety audit immediately after entire stage set up is done.	KLCO Safety committee / Production Safety representative
							0		5) Appoint Production Safety Representative	KLCO Safety committee / Production Safety representative

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		2) Broken glass on stage	1) Body injury (acute), especially for scene that requires cast to lie down on stage	none	4	2	8		1) Props should not be made of glass	Director / Stage Manager
							0		2) Ensure immediate isolation of hazardous area and clean-up of broken glass.	Stage Manager
							0		3) Ensure hazardous area is communicated to all cast members	Assistant Stage Manager

TYPES OF ACTIVITY / TASK		Performance (Cast)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		3) Complete darkness on stage left staircase during chorus and children's exit	1) Body injury (acute) due to falling	1) Ineffective glow tape used on staircase	5	2	10		1) Ensure sufficient lighting on stage wing staircase	Stage Manager
			2) Body injury (acute) due to stampede		5	3	15		2) Use glow sticks instead of glow tape	Stage Manager

Table 4.12: HIRARC of Performance (Orchestra) Activities at the Performance Venue

TYPES OF ACTIVITY / TASK		Performance (Orchestra)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
1	Orchestra rehearsal	1) Static and sustained work posture	1) Body injury (chronic)	None	5	3	15		1) Enforce mandatory breaks for orchestra members every 1 hour	Conductor / Concert Master
		2) Awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	2	10		2) Mandatory stretching and sectional warm up exercises for orchestra before rehearsal	Conductor / Concert Master / Section leader
			2) Body injury (chronic)	none	5	3	15		3) Safety briefing for orchestra	KLCO Administration
2	Transport of musical instruments into theatre	1) Sharp edges	1) Hand injury	none	4	2	8		1) Safety briefing for orchestra	KLCO Administration

TYPES OF ACTIVITY / TASK		Performance (Orchestra)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		2) Frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	none	5	2	10		2) Safety briefing for orchestra	KLCO Administration
			2) Body injury (chronic)	none	5	3	15		3) Safety briefing for orchestra	KLCO Administration
3	Orchestra performance	1) Static and sustained work posture	1) Body injury (chronic)	1) Intermission breaks (20 minutes)	5	3	15		None	
		2) Awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying.	1) Body injury (acute)	1) warm up for orchestra before performance Intermission breaks (20 minutes)	5	2	10		None	

TYPES OF ACTIVITY / TASK		Performance (Orchestra)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
			2) Body injury (chronic)	1) warm up for orchestra before performance Intermission breaks (20 minutes)	5	3	15		None	

Table 4.13: HIRARC of Performance (Audience) Activities at the Performance Venue

TYPES OF ACTIVITY / TASK		**Performance (Audience)**							**DATE: 16/10/2017**	
LOCATION		**Kuala Lumpur Performing Arts Centre, KLPAC**			**DEPARTMENT**				**SECTION / OFFICE:**	
No.	**JOB / PROCESS SEQUENCE**	**HAZARD IDENTIFICATION**		**CURRENT RISK CONTROL**	**CURRENT RISK RATING**			**LAW REQUIREMENTS**	**ADDITIONAL RISK CONTROL**	
		Hazard	**Effects**		**Likelihood**	**Severity**	**Risk Rank**		**ACTIONS RECOMMENDED**	**ACTION BY**
1	Finding designated seat	1) Dim lights	1) Tripping, body injury	1) FOH guidance	3	2	6		1) Visible markers on staircase in dim light	KLPAC Management
			2) Falling, body injury	1) FOH guidance	3	3	9		2) Visible markers on staircase in dim light	KLPAC Management
		2) Edge of staircase not marked with visible markers	1) Tripping, body injury	1) FOH guidance	3	2	6		3) Visible markers on staircase in dim light	KLPAC Management
			2) Falling, body injury	1) FOH guidance	3	3	9		4) Visible markers on staircase in dim light	KLPAC Management
		3) Static and sustained posture	1) Fatigue	1) Intermission between acts	5	1	5		None	
			2) Body pain	1) Intermission between acts	5	2	10		None	

TYPES OF ACTIVITY / TASK		Performance (Audience)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
2	Leaving theatre while show is going on	1) Dim lights	1) Tripping, body injury	1) FOH guidance	3	2	6		1) Visible markers on staircase in dim light	KLPAC Management
			2) Falling, body injury	1) FOH guidance	3	3	9		2) Visible markers on staircase in dim light	KLPAC Management
		2) Edge of staircase not marked with visible markers	1) Tripping, body injury	1) FOH guidance	3	2	6		3) Visible markers on staircase in dim light	KLPAC Management
			2) Falling, body injury	1) FOH guidance	3	3	9		4) Visible markers on staircase in dim light	KLPAC Management

TYPES OF ACTIVITY / TASK		Performance (Audience)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
3	Escape route in case of emergencies	1) Wrong exit	1) Injury / death	Pre-recorded Safety briefing that is played for the audience before the show. This briefing indicates the different exits from Pentas 1, KLPAC and advises to remain calm in wait for further instruction from KLPAC personnel in case of an emergency.	2	5	10		1) Pre-show announcement on which exits to use in case of emergencies (certain exits lead back stage). Direct audience to refer to pictorial guide on escape route provided while entering the hall.	KLCO Safety Committee

TYPES OF ACTIVITY / TASK		Performance (Audience)							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		2) Wrong escape route	1) Injury / death	Pre-recorded Safety briefing that is played for the audience before the show. This briefing indicates the different exits from Pentas 1, KLPAC and advises to remain calm in wait for further instruction from KLPAC personnel in case of an emergency.	2	5	10		2) Request pictorial guide on escape route and assembly point from theatre and give to audience as they enter the concert hall.	KLCO Safety Committee

Table 4.14: HIRARC of Hair and Make-up Activities at the Performance Venue

TYPES OF ACTIVITY / TASK		Hair and Make-up							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT		Hair and Make-up		SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
1	Hair & Make-up artists	1) Prolonged exposure to hairspray	1) Mild irritation to eyes or mouth	1) Respiratory mask	3	2	6		none	
				2) No food or drinks allowed in dressing rooms or make up room			0		none	
		2) Hot surfaces of hair irons	1) Skin burns	3) Handling by trained professionals	4	2	8		none	

Table 4.15: HIRARC of Costume Preparation and Adjustment Activities at the Performance Venue

TYPES OF ACTIVITY / TASK		Costume preparation and adjustment							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
1	Onsite costume alterations						0			
2	Guiding cast members on correct usage of costumes						0			
3	Costume fitting	1) Tripping in costume	1) Body injury (acute)	1) Ensure skirt line is not sweeping the floor when worn.	4	2	8		1) Develop final installed stage stunt safety audit checklist (include final costume inspection)	KLCO Safety committee / Production Safety representative
				2) Instruction to singers to wear secure footwear			0		2) Develop final installed stage stunt safety audit checklist (include final footwear inspection)	KLCO Safety committee / Production Safety representative

TYPES OF ACTIVITY / TASK		Costume preparation and adjustment							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
				3) Rehearsal for cast in actual costumes and footwear			0		3) Develop final installed stage stunt safety audit checklist (include suitability of costume to stunt)	KLCO Safety committee / Production Safety representative
		2) Sharp edges	1) Body injury (acute)	1) Ensure all safety pins and other cloth pins are removed from costume or that their sharp edges are securely hooked in place.	4	2	8		4) Fitting Inspection by costume designer before first rehearsal or after any costume alteration is made.	Costume Designer
							0		5) Immediate feedback from cast members to costume designer for unpadded sharp edges in costume.	Cast Members

TYPES OF ACTIVITY / TASK		Costume preparation and adjustment							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
		3) Tight costumes	1) Breathing difficulties	1) Ensure corsets and belts are not too tight for cast members	3	1	3		6) Fitting Inspection by costume designer before first rehearsal or after any costume alteration is made.	Costume Designer
							0		7) Immediate feedback from cast members to costume designer to adjust size of costume	Cast Members
			2) Body injury (acute)	1) Ensure corsets and belts are not too tight for cast members	3	2	6		8) Fitting Inspection by costume designer before first rehearsal or after any costume alteration is made.	Costume Designer

TYPES OF ACTIVITY / TASK		Costume preparation and adjustment							DATE: 16/10/2017	
LOCATION		Kuala Lumpur Performing Arts Centre, KLPAC			DEPARTMENT				SECTION / OFFICE:	
No.	JOB / PROCESS SEQUENCE	HAZARD IDENTIFICATION		CURRENT RISK CONTROL	CURRENT RISK RATING			LAW REQUIREMENTS	ADDITIONAL RISK CONTROL	
		Hazard	Effects		Likelihood	Severity	Risk Rank		ACTIONS RECOMMENDED	ACTION BY
							0		9)Immediate feedback from cast members to costume designer to adjust size of costume	Cast Members
		4) Tripping hazard due to insecure stage shoes	1) Body injury (acute)	1) Verbal reminder by costume designer to have covered shoes in black colour.	4	2	8		10) Issue pictorial guidelines to cast members on secure theatre footwear (no defects in soles, with functioning buckle if necessary)	KLCO Safety committee / Production Safety representative
							0		11) Inspection by costume designer on cast members' footwear before first rehearsal or after any change in footwear is made.	Costume Designer

4.2 Discussion

The results of the HIRARC exercise carried out in this research can be divided into two main areas. These areas are the KLCO studio and the KLPAC theatre. Most of the pre-production work for The Marriage of Figaro and rehearsals were carried out at the KLCO studio, while activities at the theatre took place on the week leading up to the performances to the public.

The hazards identified at the KLCO studio and KLPAC can be categorised according to their risk rating. Risks rated with scores higher than 15 points are imminent risks which are not tolerable. Next, those with scores from 5 points to 12 points are moderate but not tolerable. Finally, risks with ratings below 5 points are categorised as insignificant and low risk, thus tolerable.

The following sections discuss the risks found throughout the work processes carried out at both venues, categorised according to their risk rating. Final recommendations on possible major implementations to improve the risk rating are then given.

4.2.1 Safety Risk Analysis for Activities at the Rehearsal Space

The risks identified for activities carried out at KLCO studio are predominantly moderate and not tolerable (Score: 5-12). This is followed by imminent risk which is not tolerable (Score > 15) and finally insignificant and low risk which is tolerable (Score < 5). Figure 8.1 shows the composition of risk categories at KLCO studio for the production of The Marriage of Figaro.

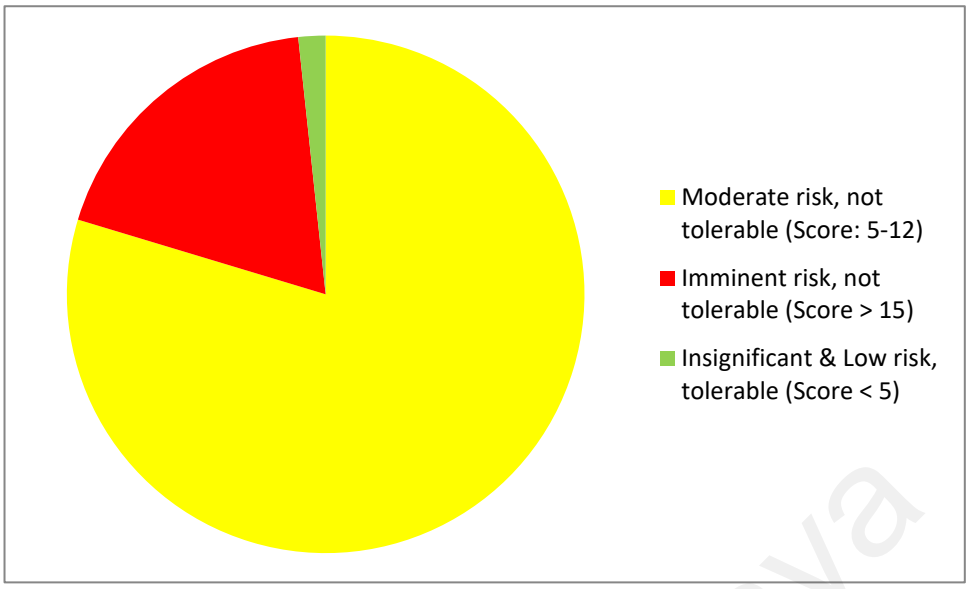

Figure 8.1: Safety Risks of Activities at KLCO Studio during the Production of The Marriage of Figaro

In terms of percentages, 80% of risks identified were found to be moderate, followed by 19% of imminent risks and 2% of insignificant risks. The following sections discuss the various risks found in each category at KLCO studio and solutions to mitigate these risks.

4.2.1.1 Insignificant and Low Risks (Score < 5)

Insignificant and low risks are tolerable but need regular review. The work done in KLCO studio contributed to one risk in this category, under costume selection and fitting. Costumes, corsets and belts which are too tight for cast members may cause breathing difficulties during dress rehearsals and performances.

4.2.1.2 Moderate risk, not tolerable (Score: 5-12)

Moderate risk is not tolerable and requires control measures to eliminate or mitigate it. The following working departments in KLCO studio were found to have risks in these categories: Marketing, administration and coordination, Production, Stage set up and management, Performance – cast, Performance – orchestra and Costume selection and fitting.

The Marketing and Administration department staff members face the risk of overexertion due to long working hours. Although Sundays have been designated as rest days, more needs to be done to avoid exhaustion among staff members.

The Production department faces the risk of awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying, tripping, sharp edges and abrasive surfaces. The costume fitting department poses tripping risks.

Cast members face the risk of vocal strain, awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying and tripping or collision. It is also necessary to highlight that cast members include children who need special consideration in terms of safety. Performance cast members who are children face possible severe tripping or collision hazards for minors as well as unauthorised visitors who might intend to cause harm. Prolonged vocal strain may lead to damaged vocal folds while the other hazards mentioned may cause bodily injuries.

The stage set up and management department faces hazards due to mishandling of breakable items, tripping or collision, which could result in acute bodily injuries. These hazards can be mitigated by conducting safety briefing for the Production Team and stage hands.

Orchestra members face the risk of awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying, excessive noise, sharp edges and tripping at the KLCO staircase while carrying large musical instruments into the studio for rehearsals. Prolonged exposure to excessive noise could result in noise induced hearing loss (NIHL) while the other hazards mentioned could results in body injury

4.2.1.3 Imminent risk, not tolerable (Score > 15)

Imminent risk is not tolerable and requires that activities are stopped until risk control measures are in place to eliminate or mitigate it. The following departments were found to have risks in these categories: Production, Stage set up and management, Performance – cast and Performance – orchestra.

The production department faces the risk of awkward work posture, frequent bending and twisting, incorrect lifting and incorrect carrying during certain phases of work. This is predominantly seen during choreography of movement and dance and set up of mock stage markers. These risks could result in acute or chronic bodily injuries among Production staff.

The stage set up and management department faces the risk of awkward work posture, frequent bending and twisting, incorrect lifting and incorrect carrying. This occurs during set movement choreography and set movement between scenes.

Cast members are exposed to substantial hazards in this category. Cast members who are minors take part in the Opera for Kids workshop at KLCO studio. The children face the risk of awkward posture, frequent bending and twisting, incorrect lifting and incorrect carrying which could result in chronic bodily injuries. All cast members rehearse together during the combined rehearsal of Principals, Chorus and orchestra. During this rehearsal, hazards come in the form of static and sustained work posture,

particularly among chorus members who sit in confined spaces while waiting for long periods. These hazards could cause chronic bodily injuries.

4.2.2 Safety Risks Analysis for activities at the Performance Venue

The risks identified for activities carried out at KLPAC are predominantly moderate and not tolerable (Score: 5-12). This is followed by imminent risk which is not tolerable (Score > 15) and finally insignificant and low risk which is tolerable (Score < 5). Figure 8,2 shows the composition of risk categories at KLPAC for the production of The Marriage of Figaro.

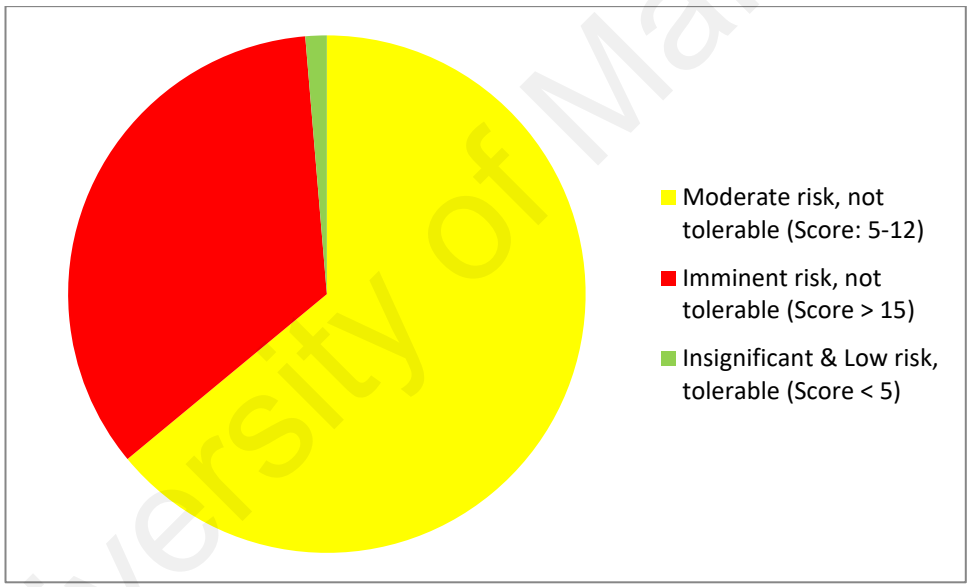

Figure 8.2: Safety Risks of Activities at KLPAC during the Production of The Marriage of Figaro

In terms of percentages, 64% of risks identified were found to be moderate, followed by 35% of imminent risks and 1% of insignificant risks. The following sections discuss the various risks found in each category at KLPAC and solutions to mitigate these risks.

4.2.2.1 Insignificant and Low Risks (Score < 5)

Insignificant and low risks are tolerable but need regular review. The work done in KLPAC contributed to one risk in this category, under costume selection and fitting due to costumes, corsets and belts being too tight for cast members and causing breathing difficulties during dress rehearsals and performances.

4.2.2.2 Moderate risk, not tolerable (Score: 5-12)

The areas found to have moderate risk based on their tasks at KLPAC are: Load-in, Front of House, Production, Performance – cast, Performance – orchestra, Performance – Audience, Hair and Make-up and Costume preparation and adjustment.

During load-in at KLPAC, unloading props at theatre through loading bay was found to have moderate risk. Setting up of the stage platform has a risk of acute body injury due to awkward work posture, frequent bending and twisting, incorrect lifting, incorrect carrying and sharp edges.

Untrained personnel carrying out work during load-in may also give rise to body injuries. The load-in will require high amount of work to be done on the theatrical rigging system. This involves suspended weights, cables and bars from the theatre ceiling, and that may block walkways that are usually unobstructed. Dangling counterweights, protruding beams resting on stage may cause body injuries due to collision and tripping. While dangling counterweights are brightly coloured to increase their visibility, the beams are not.

The Front of House (FOH) area faces risks while ushering members of the audience to their seats on show days. The hazards faced are dim lighting and unclear edges of theatre staircase. These hazards could lead to tripping and body injury among the FOH team.

Selected FOH team members were also in charge of Ushering audience and VIP from Ground Floor to Pentas 1. The Frequent ascending and descending of staircase required to carry out this task may lead to tripping and injuries. FOH members manning the ticket counters face the risk of chronic body injury due to Static and sustained work posture. The FOH manager faces all the risks mentioned for the FOH.

The Production team faces several risks in this category. Awkward work posture, frequent bending and twisting, incorrect lifting and incorrect carrying could lead to acute body injury during the setting up of stage and transfer of set and properties to the theatre. The preparation of the properties table could result in properties blocking crucial walkways during set up. This could lead to tripping and injuries. Due to space constraint backstage, there may be instances when long, cylindrical props are placed protruding out from beneath the properties table back stage with low lighting. This could lead to tripping and body injuries. Production workers could also face acute body injury due to awkward work posture, frequent bending and twisting while preparing the cast for pre-scene stand by. This includes alerting the cast at their dressing room and ensuring that properties are kept ready at the correct stage area. Production workers also face the risk of acute body injury due to sharp edges that may arise from the removal of broken properties from the stage.

Cast members face the risk of tripping and body injury while on standby backstage due to low visibility and protruding cylindrical properties from beneath the properties table. Cast members could also face acute body injury due to broken glass on the stage. This is especially dangerous if the performance requires cast members to lie down on the stage, which may be strewn with broken glass. The hazardous area should also be communicated to all cast members. Body injury due to falling may occur during the hasty exit of cast members from the stage into the completely dark backstage.

Members of the orchestra may sustain acute body injury from awkward posture, frequent bending and twisting, incorrect lifting, incorrect carrying during long rehearsals at the theatre. Chronic injury could also arise due to sustained work posture. Performances during show days may cause acute body injury to orchestra members, similar to that experienced during rehearsals.

Members of the Audience face a significant number of risks in this category. During entry and exit to and from the theatre, as well as finding their seats, the audience face dim lighting and unclear stair case edges. These hazards could give rise to tripping, falling and resulting body injuries. There is a risk of injury or death, should the audience leave the theatre via the wrong exit or embark on the wrong escape route.

The Hair and Make-up section faces prolonged exposure to volatile cosmetic products such as hairspray as well as hot surfaces such as hair irons. Exposure to volatile cosmetics could cause mild irritation to the eyes or mouth while hot surfaces could lead to skin burns.

Costume preparation and adjustment is made up of the Fashion Designers and cast members for whom the costumes are designed and adjusted. While the costume designer is trained in handling sharp needles and cutting devices, cast members may be vulnerable to injuries. Acute body injuries may occur due to sharp edges. Tripping could occur if the hemline of long skirts and dresses are sweeping the floor when worn and if corsets and belts are too tight for cast members. Finally, there is also a hazard of tripping due to insecure stage shoes. Body injury may occur as a result.

4.2.2.3 Imminent risk, not tolerable (Score > 15)

The areas found to have imminent risk based on their tasks at KLPAC are: Load-in, Front of House, Production, Performance - Technical team, Performance – cast and Performance – orchestra.

Setting up of the stage platform during load-in-in could lead to chronic body injury due to awkward posture, frequent bending and twisting, incorrect lifting and incorrect carrying. Body injury could also arise due to work done with sharp tools such as saws, nail guns, drills and while handling material with sharp edges such as plywood. Another hazard faced in this category during load-in is the lack of automated cable hoist control. The required cable for hoisting was described verbally to the operator based on relative location. This method caused the operator to be unclear on which cable to adjust, based on the verbal command given. Body injury could occur during instances when immediate emergency hoisting or lowering is needed but not possible due to human misunderstanding of verbal communication. Body injury could also occur due to worn out or burst cables when cables hit against gridlines during hoisting or lowering. There is currently a manual alert to the operator by a ground staff when an adjusted cable hits the gridline, following which the operator would make the necessary adjustments to the cable concerned. There is also a hazard of falling objects, beams and counterweights from the ceiling to the ground during load-in. Manual stage lighting adjustment on the lighting beam is done by the lighting designer from an elevated mobile lift. There is a danger of body injury from falling off this elevated mobile lift, especially when the lift is moved horizontally while the lighting designer is perched on top of the raised lift.

The Front of House (FOH) area faces risks while ushering members of the audience to their seats of show days. The hazards faced are dim lighting and unclear

edges of theatre staircase. These hazards could lead to falling and body injury among the FOH team. Selected FOH team members were also in charge of ushering audience and VIPs from the Ground Floor to Pentas 1. The Frequent ascending and descending of staircase required to carry out this task may lead to falling and injuries. FOH members manning the ticket counters face the risk of chronic body injury due to static and sustained work posture. The FOH manager faces all the risks mentioned for the FOH.

Production workers could also face chronic body injury due to awkward work posture, frequent bending and twisting while preparing the cast for pre-scene stand by. This includes alerting the cast at their dressing room and ensuring that properties are kept ready at the correct stage area. The hazard faced by the technical team in this category is static and sustained work posture. This may result in chronic body injury.

Stunts through potentially hazardous stage entrance and exit may cause body injury during the performance. Acute body injury due to stampede may occur during the hasty exit of cast members from the stage into the completely dark backstage.

Members of the orchestra may sustain chronic body injury from frequent bending and twisting, incorrect lifting, incorrect carrying during long rehearsals at the theatre. Chronic injury could also arise due to sustained work posture. The transportation of musical instruments into the theatre may lead to injuries due to sharp edges, frequent bending and twisting, incorrect lifting and incorrect carrying. Performances during show days may cause chronic body injury to orchestra members, similar to rehearsals.

4.3 Risk Mitigation Measures

Based on the actions and recommendations of the HIRARC exercise done on the production of The Marriage of Figaro by KLCO, a few risk mitigation measures have

been identified. The following general steps can be taken to ensure that the risks identified are either eliminated or receive adequate control: (1) Develop a General Working Procedure (GWP) for activities carried out by KLCO, (2) Develop a Safety Procedure for activities carried out by KLCO, (3) Develop a Safety Procedure for activities carried out by external contractors in KLCO's productions, (4) Procurement and maintenance of personnel protection equipment (PPE), (5) Procurement and maintenance of supporting equipment, (6) Develop training content and provide training for all KLCO production members, (7) Record a list of proposed improvements to the performance venue after each production, (8) Develop a close-out report for each production and (9) Ensure annual review of existing procedures.

As highlighted in previous sections, production work includes work done at the KLCO studio and the performance venue such as KLPAC in the case of The Marriage of Figaro. As established performance venues have their own procedures, once KLCO enters the theatre, the official procedures of the theatre should take precedence over KLCO's procedures where ever there is a discrepancy. The following sections highlight the various elements to be included in each step outlined above, based on the results of this study.

4.3.1 General Working Procedure

A General Working Procedure (GWP) should be developed for activities carried out by KLCO to serve as a central reference point by all production members. The GWP should contain the following elements:

1) Responsibility matrix for each position according to the typical production and administrative tasks to be carried out by the Company. The responsibility matrix may serve as the starting point for production work, with possible adjustments by the Stage

Manager to suit each production. The Company's approval must be sought prior to making adjustments.

2) Requirement of maximum meeting duration. Meetings held should not exceed 10pm and have hourly breaks.

3) Medical claim criteria for illness and injuries incurred as a result of production work.

4) Allocation of adequate rest days from Production work, ie. one complete rest day per week.

5) Movement of heavy set should be done by trained movers.

6) Emergency contact numbers required for clear display at the studio, ie. next to the studio telephone and on notice boards.

7) Guideline on Orchestra rehearsal requirements for hourly breaks and meeting the 10pm cut-off time.

8) Important aspects to be covered in Front of House (FOH) briefing prior to show days. These aspects include FOH team working hours, requirements to be rested prior to the shows and task delegation by FOH manager during peak hour.

9) Requirement for appointment of a Production Safety Representative.

10) Requirement to appoint one dedicated Assistant Stage Manager for Stage Left, and one dedicated Stage Manager for Stage Right

11) Pictorial guidelines to cast members on secure theatre footwear, ie with no defects in soles and with functioning buckle if necessary.

11) Requirement for inspection by costume designer on cast members' footwear before first rehearsal or after any change in footwear is made.

4.3.2 Internal Safety Procedure

A Safety Procedure for activities carried out by KLCO should be developed to highlight all the required Safety checkpoints for safer working methods. The safety procedure should be cover elements within KLCO studio and within the performance venue:

4.3.2.1 Internal Safety Procedure at KLCO studio

KLCO productions done at the KLCO studio should adhere to guidelines in the Internal Safety Procedure. The elements to be covered in the procedure are as follows:

1) Allocation of adequate rest days from Production work, i.e. one complete rest day per week.

2) Requirement of maximum meeting duration. Meetings held should not exceed 10pm and have hourly breaks.

3) Requirement for visible pictorial signage on ergonomic posture related do's and don'ts.

4) Requirement for safety briefing for stage hands and Production Team.

5) Requirement for usage of adequate PPE while carrying out hazardous tasks, ie. gloves while using sandpaper.

6) Requirement for mandatory warm up exercises before dance or stage rehearsal. This can be done by ensuring visible pictorial signage on proper warm up exercises is provided at the rehearsal space.

7) Requirement for caution during heavy lifting activities through the studio staircase. This can be done by ensuring visible pictorial signage to exercise caution while lifting items via staircase is provided at the stairwell.

8) Requirement for immediate clearing of broken items from mock stage area at the studio.

9) Requirement for set movement choreography to be done with safety of set movers and cast members as top priority. It should be stated clearly that artistic intent and aesthetics are secondary to safety.

10) Requirement for movement of heavy or complex set should be done by trained movers or trained stage hands

11) Requirement to ensure vocal warm up before singing rehearsals. Adequate planning for warm up time within a rehearsal is necessary. If it is foreseen that there might be insufficient time for group vocal warm up, instruction should be given to singers to do proper vocal warm up prior to rehearsals.

12) Items to be covered in Safety briefing for stage hands and cast members.

13) Requirement to ensure warm up and cool down exercises are done before and after rehearsals, respectively.

14) Requirement for visible signage on do's and don'ts to remind Opera for Kids participants to abide by rules at all times.

15) Items to be covered in Safety briefing for Opera for Kids participants.

16) Emergency contact numbers required for clear display at the studio, ie. next to the studio telephone and on notice boards.

17) Guideline on Orchestra rehearsal requirements for hourly breaks and meeting the 10pm cut-off time.

18) Requirement for sectional warm up exercises for orchestra before rehearsals.

19) Requirement for visible signage on warming up before rehearsals.

20) Requirement for visible pictorial signage to remind singers to take a break from sitting or do stretching exercises outside the rehearsal space while waiting for their next appearance.

21) Items to be covered in Safety briefing for the orchestra.

22) Requirements for costume design, including a margin on height measurement to prevent cast members from tripping in their costumes.

23) Requirement that a list of stunts is prepared for each production and mapped with the desired costume. The costume designer can alter the costume as reasonably practicable. If the alteration is insufficient, the stunt should be altered accordingly to ensure safety of cast members.

24) Requirement for inspection by costume designer on costumes and footwear before the first rehearsal or after any costume or footwear alteration is made.

25) Instruction to all cast members to provide immediate feedback to the costume designer in case of unpadded sharp edges in costume.

26) Requirement to issue pictorial guidelines to cast members on secure theatre footwear, ie. footwear with no defects in soles and with functioning buckle if necessary.

4.3.2.2 External Safety Procedure at performance venues

KLCO productions done at external performance venues should also adhere to guidelines in the External Safety Procedure. The elements to be covered in the procedure are as follows:

1) Requirement for adequate personnel protection equipment (PPE) while carrying out tasks at the theatre. Examples of PPE are gloves, covered shoes, long pants.

2) Requirement for portable signage to be displayed, indicating high risk workstations.

3) Items to be covered in safety briefing for Cast members on load-in hazards, prior to load-in at the theatre.

4) Requirement for Safety helmets to be worn by all workers while cable hoisting activities are in progress within the workspace.

5) Requirement for front of house (FOH) team to be equipped with flashlights for clear visibility during their tasks at the theatre.

6) Items to be covered in FOH team briefing on their work hours and reminder to be well rested prior to the shows.

7) Requirement for task delegation by the FOH Manager to the FOH crew during peak hours, ie. before the start of the concert and during the intermission.

8) Requirement for visible pictorial signage on ergonomic posture related do's and don'ts and the proper practice of ergonomics at the workplace.

9) Items to be covered in safety briefing for stage hands and Production Team.

10) Requirement that all props should be placed against the wall while setting up the props table.

11) Requirement that all long cylindrical props are placed in a dedicated holder next to props table.

12) Stage stunt safety audit check list and requirement that stage stunt safety audit should be carried out immediately after the entire stage set up is done. The check list should include the provision of sufficient flat landing clearance for scenes where a cast member jumps from onstage to offstage (eg: in The Marriage of Figaro, the character Cherubino jumps from onstage to offstage, while Antonio is shoved from onstage to offstage).

13) Requirement for appointing a Production Safety Representative.

14) Requirement for PPE while handling sharp edges.

15) Requirement for preparing a dedicated bin back stage for the disposal of sharp objects.

16) Requirement that safety briefings should include warning of low visibility back stage.

17) Requirement for a Safety Review of Stage design plans.

18) Requirement that props should not be made of glass as far as reasonably practicable.

19) Requirement for immediate isolation of hazardous area due to broken glass and clean-up of the broken shards of glass.

20) Requirement for hazardous area onstage and backstage to be communicated to all cast members and production workers on duty.

21) Requirement for sufficient lighting on stage wing staircase.

22) Requirement for the glow sticks instead of glow tape to mark the edge of stage wing staircase.

23) Requirement for hourly breaks for the orchestra during rehearsals.

24) Requirement for stretching and sectional warm up exercises by the orchestra before rehearsal.

25) Items to be covered in safety briefing for the orchestra.

26) Items to be covered in pre-show announcement to the audience on which exits to use in case of emergencies (certain exits lead back stage, while others lead to the exterior of the theatre). The announcement should direct audience to refer to a pictorial guide of the escape route provided while entering the performance hall.

27) Requirement for a pictorial guide on emergency escape route and assembly point from the theatre. This pictorial guide should be communicated to the audience as they enter the performance hall.

28) Final installed stage stunt safety audit checklist that includes the inspection of final footwear, costume and suitability of costume to stunt.

29) Requirement for immediate feedback from cast members to costume designer for unpadded sharp edges in costume.

30) Requirement for issuance of pictorial guidelines to cast members on secure theatre footwear (there should be no defect in soles and footwear should have a functioning buckle if necessary).

31) Requirement for inspection by the costume designer on costumes and footwear before the first rehearsal or after any costume or footwear alteration is made.

4.3.3 External Contractor's Safety Procedure

A Safety Procedure for activities carried out by external contractors in KLCO's productions should be developed to highlight all the required Safety checkpoints to be adhered by them while carrying out work for KLCO. The external safety procedure should contain the following elements:

1) A responsibility matrix for each production task. This matrix may be a generic matrix, to be fine-tuned or edited if necessary according to each project by the Stage Manager and KLCO Administration.

2) Requirement to employ trained movers or requirement to provide proper training for stage hands in charge of complex set movement.

3) Requirement for the Costume Designer to include a margin for cast members' height measurement to prevent tripping in costumes.

4) Requirement for a fitting inspection by the costume designer before the first rehearsal or after any costume alteration is made.

5) Requirement for immediate feedback from cast members to the costume designer for unpadded sharp edges in costumes.

6) Requirement for inspection by costume designer on cast members' footwear before the first rehearsal or after any change in footwear is made.

7) Requirement for the usage of adequate PPE:

- Examples of PPE are safety helmet, gloves, covered shoes, long pants, covered footwear and long pants)
- Safety helmet should be worn by all workers while cable hoisting activities are in progress while moving the portable lift.

8) Requirement for visible pictorial signage on ergonomic posture related do's and don'ts and its application by workers.

9) Requirement to conduct a stage stunt safety audit immediately after entire stage set .

10) Fitting inspection by costume designer before first rehearsal or after any costume alteration is made. Costume Designer

11) Requirement for immediate feedback to cast members by the costume designer for unpadded sharp edges in costume and for costume size alteration.

12) Requirement to issue pictorial guidelines to cast members on secure theatre footwear with no deffects in soles and with functioning buckle if necessary.

13) Requirement for inspection by costume designer on cast members' footwear before first rehearsal or after any change in footwear is made.

4.3.4 Personnel Protective Equipment

Required personnel protection equipment (PPE) should be procured for carrying out production work at KLCO and the performance venue safely. Adequate maintenance should also be ensured for optimal performance of the PPE when used. The elements to be considered are identified in the following subsections.

4.3.5 Personnel Protective Equipment at KLCO studio

Requirements for PPE at the rehearsal space are as follows:

1) Requirement for gloves while using sandpaper on properties and set items

2) Requirements for Safety briefing for stage hands and Production Team, cast members and orchestra on the usage of PPE.

3) Requirement for the immediate clearing of broken items from the mock stage area using adequate PPE such as hand gloves and closed footwear.

4) Requirement for set movement choreography to be done with adequate PPE such as hand gloves. Safety of set movers and cast members should be the top priority, followed by artistic intent as well as aesthetics.

4.3.6 Personnel Protective Equipment at the Theatre

Requirements for PPE at the theatre are as follows:

1) Requirement for using adequate PPE such as helmet, gloves, covered shoes, long pants, covered footwear and long pants. Safety helmet should be worn by all workers while cable hoisting activities are in progress while moving the portable lift.

2) Requirement for Safety briefing on usage of PPE for stage hands and Production Team.

4.3.7 Supporting Equipment

Required supporting equipment should be procured to facilitate safer working methods at KLCO and the performance venue. Adequate maintenance should also be ensured for optimal equipment functionality when used. The supporting equipment that should be procured and installed are as follows:

1) Supporting Equipment at KLCO studio are the iinstallation of CCTV and intercom to monitor the doorway of studio and selectively allow entrance by authorised persons and to supply orchestra members with noise dosimeters and train them on how to read noise exposure at the end of their working day.

2) Supporting Equipment to be used at the performance venue are flashlights, glow sticks and a dedicated bin back stage for broken sharp objects.

4.3.8 Training

Safety and work processes training content should be developed for all KLCO production members. Adequate training should be given to all affected members in a timely fashion so that each person involved is fully aware of his or her responsibilities and is able to carry them out safely. The elements to be covered in the trainings provided (related to safety, work processes and equipment handling) are identified in the following subsections.

4.3.9 Training for work at KLCO

Training should be provided to foster safer working methods at KLCO and the performance venue. Training can be incorporated into general Safety briefings or individual training can be organised to cover specific practices. The elements that should be included in training for all those involved in productions are as follows:

1) Communicate a responsibility matrix of each task to all trainees.

2) Train all workers and volunteers on Safety issues. Safety briefing should be carried out for stage hands and the Production Team.

3) Employ trained movers or train stage hands for complex set movement .

4) Provide training to orchestra members on usage of noise dosimeters and how to read noise exposure at the end of their working day.

5) Provide training to orchestra members on Noise Induced Hearing Loss.

6) Provide training to orchestra members on the Permissible Exposure Limits for continuous (=< 90dB), Action Level (85 dB) and impulsive (=<140 dB) noise exposure so that they can make informed decisions about the quantity of hours spent being exposed to noise via performances and rehearsals.

7) Provide training on ergonomics at the workplace.

8) Provide training on the proper usage and maintenance of personnel protection equipment at the workplace.

9) Provide training on interpreting safety signage especially for high risk workstations.

10) Safety briefing for Cast members should include theatre load-in and load-out hazards prior to load-in at the theatre.

11) Training should be provided on the importance of supporting equipment such as flashlights and how to use them effectively in carrying out duties safely.

12) Safety briefing for the FOH team should include their work hours and reminders for them to be well rested prior to each show. Task delegation should also be covered for peak hours (before each concert and during the intermission).

13) Safety briefing should be conducted for all those involved in the production.

14) Safety briefing for property handlers and stage hands should include reminders to ensure that all properties are placed against the wall while setting up the properties table to ensure obstruction-free walkways during load-in.

15) Results of safety audits on the stage set up should be addressed and safeguards involving human behaviour should be included in a safety briefing to all those involved in the production.

16) Safety briefing should include awareness of all cast, stagehands and stage managers on the dedicated bin prepared back stage for sharp broken objects. The bin should be emptied safely at the end of the production or once it is full, which ever come first.

17) Safety briefing for cast, stagehands and production workers should include a warning of low visibility back stage. Those who are not involved backstage during the performances should be advised to stay clear of the backstage area due to low visibility.

18) Stagehands in charge of properties should be briefed to ensure all long cylindrical props are placed in dedicated holders next to properties table, instead of lying on the ground backstage, posing a tripping hazard.

19) Safety training and briefings should be arranged by an appointed Production Safety Representative. All those involved in the production should be made aware of his or her identity and contact number for ease of communication.

20) Safety briefing should include methods to ensure that hazardous areas are communicated immediately to all cast members and production workers during the show.

21) Cast members should be trained to notice hazards (e.g. sharp edges, length too long or too tight) in their costumes and highlight them to the costume designer or alteration.

22) Issue pictorial guidelines to cast members on secure theatre footwear (no defects in soles, with functioning buckle if necessary).

4.3.10 Proposed Improvements to the Performance Venue

A list of proposed improvements to the performance venue should be compiled after each production and shared with the management of the venue. This is to highlight safety issues that should be handled under the purview of the performance venue so that

future productions can be done in a safer manner. This ensures that issues from each production are communicated to the performance venue management for continuous improvement in safety.

4.3.11 Production Close-out Report

A close-out report should be developed for each production with lessons learnt to highlight areas of improvement for future productions. The elements to be included in the close-out reports should cover all aspects of the production. There should also be a safety section that highlights all safety issues faced during the production for record.

4.3.12 Annual Review

Annual reviews of all procedures should be carried out to ensure that all processes and risk mitigation measures are continuously improved. The elements to be included in the annual review of procedures are can be based on lessons learnt from the latest productions. Production Close-out Reports can be used to propose new improvements to current processes and procedures.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.0 Conclusion and Recommendations

This research study has identified the physical Hazards in The Marriage of Figaro, which is a performing arts theatre production (Western Opera) by a Malaysian theatre company, Kuala Lumpur City Opera, KLCO. The Marriage of Figaro was performed on the 12th, 14th and 15th of October 2017 at the Kuala Lumpur Performing Arts Centre, KLPAC. The research study has analysed and quantified the likelihood and severity of physical hazards on the well-being of theatre practitioners and members of the public. It has also identified measures to control the risks.

5.1 Conclusion

The HIRARC exercise carried out on the production of The Marriage of Figaro by KLCO has identified the physical hazards faced by cast members, production workers, contractors and all other parties directly involved in each phase of its production. The physical hazards identified at the rehearsal venue, KLCO studio, and the performance venue, KLPAC, are mainly moderate risks, followed by imminent risks and finally, insignificant risks. A few major risks are falling objects, falling, sharp edges, awkward work posture, frequent bending and twisting, incorrect lifting and incorrect carrying during certain phases of work At the rehearsal venue, 80% of risks identified were moderate, followed by 19% imminent and 2% insignificant risks. The performance venue showed 64% of moderate risk, followed by 35% imminent risks and 1% insignificant.

Steps have been identified to mitigate each risk identified. All mitigation measures can be captured under the preparation and implementation of the following items: General Working Procedure (GWP) for activities carried out by KLCO; Safety

Procedure for activities carried out by KLCO; Safety Procedure for activities carried out by external contractors in KLCO's productions; Procurement and maintenance of PPE; Procurement and maintenance of supporting equipment; Develop training content and provide training for all KLCO production members; Record a list of proposed improvements to the performance venue after each production; Develop a close-out report for each production; and ensure annual review of existing procedures.

5.2 Recommendations

The implementation of risk mitigation steps identified in this research would serve as the first step towards ensuring safety at the theatre, especially in the face of lacking regulations on the Malaysian performing arts theatre industry. Future study in this field could be to investigate the resulting risk level of a Malaysian theatre production with these mitigation measures firmly implemented. Concrete rubrics on the determination of risk likelihood and severity specifically for the performing arts theatre industry could also be developed and issued as a guideline for Malaysian theatre practitioners.

Additionally, research can be carried out on Cleaner Production methods in Malaysian performing arts theatre processes to make the field more environmentally friendly and efficient. Four main elements of Cleaner Production are the precautionary approach, preventive approach, democratic control and integrated as well as holistic approach. Cleaner Production methods that can be researched include waste minimisation, environmental design and on-site recycling.

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